An Evaluation of Sea Turtle Abundances, Mortalities and Fisheries Interactions in the Chesapeake Bay, Virginia, 2001

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Final Report

Submitted to:

National Marine Fisheries Service
Fisheries Science Center/Northeast Region
One Blackburn Drive
Gloucester, MA 01930
Contract #: 43-EA-NF-110773

Commercial Fishing Advisory Board
Virginia Marine Resources Commission
2600 Washington Avenue
Newport News, VA 23607
Contract#: CF01-1

April 2002

TABLE OF CONTENTS

INTRODUCTION:

Since 1979, the Virginia Institute of Marine Science (VIMS) Sea Turtle Research Program has served as the Commonwealth's center for sea turtle research and conservation. The primary goal of this program is to assess and monitor sea turtle mortalities and population trends within the Chesapeake Bay and coastal waters of Virginia. This has been accomplished through the management of a statewide sea turtle stranding network, aerial population research, behavioral studies using radio and satellite telemetry, and age and growth research.

A major migratory pathway for loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempi*) and leatherback (*Dermochelys coriacea*) sea turtles exists between Cape Hatteras, North Carolina and Virginia (Shoop et al, 1981; Shoop and Kenney, 1992; Keinath et al., 1994). Each year, between 200 and 400 sea turtle stranding deaths are recorded within Virginia's waters. The vast majority of these strandings are juvenile loggerhead and Kemp's ridley sea turtles. Historic stranding data show that 50.0% to 55.0% of the yearly turtle deaths occur in May and June when the turtles first enter the Bay (Lutcavage, 1981; Lutcavage and Musick, 1985; Keinath et al., 1987; Coles 1999). At the time when stranding counts are highest, mean water temperatures range between 18° and 22° C (Coles, 1999). Kemp's ridleys also have an additional peak in strandings in the fall (October and November) when temperatures begin to drop (Lutcavage and Musick, 1985; Coles, 1999). Despite the VIMS Sea Turtle Research program's conservation efforts, a significant number of sea turtle mortalities still occur each year within Virginia; state stranding counts have risen steadily over the last ten years. This increase may in part be due to either intensified fishing interactions, an increase in the sea turtle population. To address this problem, VIMS, under contract and supplemental funding from the National Marine Fisheries Service and Virginia's Commercial Fishing Advisory Board, conducted aerial, surface and sub-surface fisheries surveys and aerial sea turtle population surveys in the Chesapeake Bay during the 2001 season.

Sources of Sea Turtle Mortality:

Despite the fact that all reported strandings are examined to determine cause of death, the majority of turtle strandings show no signs of illness, fishery interaction or other human induced mortality. This is in part due to the relative decomposition rates of the turtles. Decomposition studies in the 1980's indicated that turtles may take up to two or three weeks to fully decompose during the warmer months of the season (Bellmund et al., 1987). It is probable that many of the turtles observed stranded on the beaches may have died several days or even weeks prior to discovery. Using standardized carcass condition codes, it may be possible to refine the start time of spring stranding events and better identify sources of mortality occurring within that timeframe.

The fraction of strandings examined that exhibit evidence of a probable cause of death include turtles that have been hit by boats, ingested fishing line or hooks, cold stunned animals, turtles that have gunshot, hammer-like or knife wounds, and turtles with bruising or marks of net entanglement around their flippers or neck (Coles, 1999). Some constriction-like wounds may occur post mortem. Virginia's turtles have also been observed to interact with a variety of fishing gears and commercial vessels including whelk and crab pots, poundnet leaders (>12 inch stretch), large mesh (> 12 inch stretch) gillnets, longline and trawling gear, and dredges (Musick et al., 1984; Bellmund et al., 1987). Nets that have long soak times, particularly poundnet leaders, may entangle sea turtles sub-surface and are at risk of not being observed or included in mortality estimates. Sub-surface entanglements by fishery have not been quantified since the 1980's.

Sources of sea turtle mortality have not remained constant over time within Virginia's waters. In 1989, VIMS stranding data aided in the closure of the flounder otter trawl fishery within state waters. Shortly after the closure, strandings decreased substantially (Musick, 1995). In the early 1980's, between 3% and 33% of sea turtle mortalities were attributed to large mesh poundnet leaders (> 12 in stretch) (Musick et al., 1984; Bellmund et al, 1987). The poundnet fishery in Virginia has declined significantly since the 1980's. At that time, 300 nets were active in the main-stem Chesapeake Bay, with over 170 large mesh nets present (Musick et al., 1984; Bellmund et al., 1987). There are currently less than 100 active nets in the Bay, with less than 20 active large mesh nets (Mansfield et al., 2001). Despite this, the number of sea turtle strandings in spring has been rising in recent years. Mortalities induced by the poundnet fishery in the 1980's may have been replaced by a rapidly expanding spring gillnet fishery focused on both the seaside and lower bayside of Virginia's Eastern Shore and off Virginia Beach. It is possible that the large mesh gill nets used in the monkfish (*Lophius americanus*); black drum (*Pogonis cromis*) and smooth dogfish (*Mustelus canis*) fisheries pose a threat to sea turtles.

The 1998 through 2001 seasons resulted in a large number of strandings in the southern Bay, particularly the beaches of Fisherman's Island, Kiptopeke State Park and Sunset beach areas of Northampton County. This is an area with several large-mesh poundnets located just offshore of its beaches. It is also an area in close proximity to other commercial fishing activities including the spring gill net fisheries (Terwilliger and Musick, 1995). In addition to black drum and smooth dogfish, gill-netters have recently begun to target the monkfish in May and June. Data generated by the VIMS sea turtle stranding database were utilized by National Marine Fisheries Service (NMFS) managers to enact emergency fisheries regulations in Virginia's waters during the 2000 stranding season. For 30 days beginning May 12, 2000, the use of all large mesh gillnets were prohibited in Virginia waters. This period coincided with historic peaks in the number of strandings observed by VIMS since 1979. Late spring and early summer stranding data were analyzed and a significant drop in sea turtle mortalities was observed (Mansfield et al., 2001).

To date, there is no sea turtle take limit established for the poundnet or gillnet fisheries in Virginia and Maryland. Therefore, by law, no takes are currently permitted in either state. In order to quantify the level of take occurring within the Bay gillnet and poundnet fisheries, real-time monitoring of sea turtle mortalities and direct assessments of fishery-induced mortalities is necessary. Poundnets typically do not target any particular species of fish. They are passive fishing devices that fish swim into and become trapped within. Sea turtles may interact with these nets in two ways: sea turtles are known to swim into these nets to feed (Lutcavage, 1981; Lutcavage and Musick, 1985) and they have been observed entangled within the larger meshed leaders (Musick et al., 1984; Bellmund et al., 1987). Once inside a pound, turtles are trapped and must be released by the fisherman. The pound itself is a bowl-shaped small meshed net similar to a live well that is open at the surface, allowing trapped turtles to surface and breathe.

Understanding sea turtle mortality due to poundnet interaction is a current priority within the National Marine Fisheries Service (NMFS) Northeast Region. Many of these larger mesh nets are set in the lower Chesapeake Bay, along the southern tip of the Eastern Shore where currents are strong. These nets may entangle turtles when they first enter the Bay in the spring. They may also trap dead, floating turtle carcasses that drift into the Bay with the tides and currents. This is a region where high numbers of sea turtle mortalities are recorded annually. At the time of the spring immigration, many of the turtles are emaciated and weak (Bellmund, 1988) and may have difficulty navigating around nets. Historically, these mortalities drop off substantially by the middle to end of June. Turtles tracked via radio telemetry in the summer and fall were able to forage around the nets with little threat (Musick et al., 1985; Byles, 1988).

Sub-surface SCUBA studies conducted in the 1980's indicated that the majority of sea turtles become entangled within the upper two meters of netting (Musick et al., 1984). These entanglement events occurred beginning late May, slowly increasing through the first two weeks of June and peaking in late June (Bellmund et al., 1987). Very few entanglements were observed after June, indicating that turtles may be at risk of entanglement for only a fraction of their residence time in the Chesapeake Bay. Early SCUBA studies were time consuming and placed divers in low visibility and high current situations that increased the risk of researchers becoming entangled in the same nets as the turtles. These surveys were also conducted during the earlier portion of the stranding season and did not evaluate sub-surface mortalities after the peak of strandings had occurred (Musick et al., 1985). One alternative method of assessing sub-surface by-catch is through he use of side scan sonar. Kasul and Dickerson (1993) explored the feasibility of using acoustic methods to detect sea turtles sub-surface. They cited unpublished data supporting the ability of a 500 KHz side scan sonar to detect turtle carcasses and carapaces placed on the seabed. No work has been published evaluating the use of side scan sonar in detecting sea turtle carcasses entangled in netting and/or suspended within the water column. This report evaluates the use of side scan sonar in assessing sub-surface sea turtle bycatch mortalities in poundnet and gillnet fisheries.

Virginia Sea Turtle Sub-Population Estimates:

One of the goals set forth by NMFS and the Turtle Expert Working Group (TEWG) in the recovery plan for Atlantic sea turtles includes identifying the maximum number of individual turtles (per species) that may be taken incidentally by a fishery while still allowing for the recovery of the species (TEWG, 2000). In order to accomplish this goal, it is imperative that the status and condition of existing sea turtle stocks be understood (TEWG, 2000). During the early 1980's, mark-recapture population modeling indicated that approximately 3,000 sea turtles inhabited the Bay each year (Lutcavage, 1981; Lutcavage and Musick, 1985). Due to sampling size and the possibility that some assumptions associated with the population model may not have been met, this number was deemed a minimum estimate. The VIMS Sea Turtle Research Program has used aerial surveys to determine relative abundance and seasonal distribution of sea turtles found in Chesapeake Bay and coastal waters (Byles, 1988; Keinath et al., 1987). Aerial surveys conducted between 1982-1985 and 1994 indicated that 6,500 to 9,700 and 3,000 turtles respectively are found in Virginia's lower Bay waters in any given season (Byles, 1988; Musick et al., 1984; Keinath, 1993). These estimates were based on the number of aerially observed sea turtles extrapolated to account for the entire Chesapeake Bay. Estimates were adjusted to reflect surfacing times and diving behavior. The largest numbers of sea turtles were observed during the spring of the year, implying that the greatest sea turtle abundances occurred within the spring. Sea turtle population estimates for the Chesapeake Bay have not been quantified in over 10 years due to lack of available funding. This report provides current estimates of sea turtle standing stocks in the Chesapeake Bay from aerial surveys conducted during the 2001 season. These numbers are compared to historic estimates made in the mid-1980s to determine whether these stocks are increasing or declining.

OBJECTIVES:

- To monitor real-time sea turtle mortalities to determine where and when commercial fisheries may pose a threat to sea turtles in the Chesapeake Bay;
- To evaluate the use of side scan sonar as a tool for determining the presence of sub-surface sea turtle entanglements and to provide estimates of by-catch mortality for Bay fisheries;
- To provide a quantitative description and characterization of the Chesapeake Bay gillnet fisheries; and
- To conduct aerial surveys in the Chesapeake Bay, Virginia (in conjunction with contracted aerial work for the Commercial Fishing Advisory Board) to document the location of sea turtles and fishing gear deployment during the spring.

METHODS:

Sea Turtle Strandings:

Dead or live stranded sea turtles throughout the state are reported to VIMS or a network cooperative. All stranded turtles that network participants respond to are identified as to species and size class (adult or juvenile). Turtles are measured (carapace, plastron and head) and when possible, necropsied. The relative condition of each animal is also determined based on a standardized condition index established by NMFS:

0 = Alive
1 = Fresh Dead
2 = Moderately Decomposed
3 = Severely Decomposed
4 = Dried Carcass
5 = Skeleton, Bones only

Gut samples were also collected from relatively fresh dead turtles. Samples were examined and quantified by major prey groups, including mollusks, crustaceans, horseshoe crabs (chelicerates), and fish. Sea turtle stranding locations were divided geographically into five regions: Western Bay, Eastern Shore-Bay, Eastern Shore-Ocean, Virginia Beach-Ocean and Southern Bay (Figure 1). Bay and ocean regions are divided by the Chesapeake Bay Bridge Tunnel—regions east of the Bridge Tunnel are considered ocean, and west of the tunnel, Bay.

Fisheries Surveys:

A base-line poundnet survey was conducted by VIMS in 2001 to establish current locations and mesh sizes of all poundnets within the main-stem Chesapeake Bay compared to the fall poundnet survey of 2000 (Mansfield et al., 2001). From June 1 through October 31, 2001, all poundnets within Virginia's main stem Chesapeake Bay, and approximately five miles up river of the major tributaries, were located and recorded. Poundnet stands were first located by a shoreline aerial survey. The survey area corresponded to the known distribution of sea turtles within the Chesapeake Bay (Bellmund et al., 1987; Keinath et al., 1987; Byles, 1988). Flights were conducted at a speed of 130 km/hr and altitude of 152 meters (approximately 500 feet). The latitude and longitude of all poundnet stands were recorded and all stands were mapped in reference to local features. All poundnet stands identified by aerial survey were subsequently accessed by boat. The exact location of all poundnet stands, their fishing status, depth, latitude and longitude, and leader mesh sizes were recorded. The type of leader was recorded for each net (mesh, stringer or buoy), observations were made regarding the fishing status of both the leader and the pound and license information was recorded. All sea turtle mortalities were documented.

Though not required in the scope of work for this project, mesh size measurements were also taken (when possible) for the poundnet stands that had active leaders. Mesh size was recorded in centimeters as both knot-to-knot, or bar, and stretch (Figure 2). While stretch measurements are typically twice the length of bar measurements, the majority of the poundnet leaders in the Chesapeake Bay are hand-made and the mesh may not form perfect squares, thus some stretch measurements taken may not represent exactly double the knot-to-knot, or bar, measurements. The leader may also be under strain from strong tidal currents or tight fits between poles, further reducing the ability of the measurer to fully stretch the mesh to the maximum stretched point. Thus, we found that bar measurements were the more reliable measurement to use when quantifying the mesh size of poundnet leaders in the Chesapeake Bay.

Gillnet activity was recorded during aerial sea turtle population surveys (see aerial methodology below). Locations of gillnets set in the Chesapeake Bay during each aerial survey (June through October) were recorded and plotted in ArcView 3.2. The fishery was also characterized based on landings/harvest data obtained from the Virginia Marine Resources Commission. Unfortunately, mesh sizes of gillnets observed could not be determined since it required that VIMS illegally haul up each net in order to perform mesh size measurements.

Side Scan Survey:

A *Marine Sonics Technology* side scan sonar system was used to scan poundnet leaders and gillnets for sub-surface sea turtle entanglements. A 900 kHz side scan sonar tow fish was used (Plate 1), providing high-resolution digital sonar data, with a resolution of 0.1 meter that was processed in an on-board computer, providing real time data management and storage. The unit also allowed the bottom sediment features and structures suspended within the water column to be viewed on a large format monitor.

The system operated on a *Microsoft Windows* based program for ease of data management while a side scan review program (Sea Scan PC Review 2.0) allowed for post-processing and viewing of all survey sites. Frozen sea turtle carcasses of varying sizes and species were placed within the leader of a sample net. These specimens, representing some of the smallest size classes common to Virginia (35 cm to 50.0 cm CCL), were scanned and compared to base-line scans of the net in order to determine whether the turtles have an acoustic signature when suspended within the water column (Plates 2-3). Other objects that may produce similar acoustic signatures were tested, including garbage bags (Heftytm 50 gallon bags; Plate 4), seagrass, dead fish, etc. Kasul and Dickerson (1993) tested for the acoustic signatures of horseshoe crabs (*Limulus polyphemus*), however, due to severe population declines within the Chesapeake Bay (ASMFC, 1998) and the low probability of encountering them suspended within a poundnet leader, they were not ground truthed for this study.

All poundnets in the main-stem Chesapeake Bay were scanned early in the sea turtle residency season to establish a base-line image of each net. The sonar was towed at a depth of one meter, a speed of 2.0-3.5 knots and a distance of 10 to 20 meters from the net. Depth and navigation permitting, scans were conducted along both lengths of the net—typically along the up current and down current sides of each net. Leader poles were counted during scans, and the location, indicated by pole number, of any acoustic signature similar to that of a sea turtle was recorded. Once the scan was complete, potential sea turtle signatures were verified by returning to the target's location along the net and recording any objects present at surface or at depth. Each net was monitored throughout the season, weather and sea conditions permitting. Subsequent scans were compared to archived base-line images of each net to determine the presence of potential acoustic targets—particularly at depth, below the level of visibility.

Side scan sonar sampling (particularly of the gillnet fishery) was to be stratified by area and season. However, the gillnet surveys were dependent on fishing effort assessed from the aerial over flights. Due to the small numbers of gillnets observed, only test scans could be performed.

Aerial Monitoring:

Aerial surveys were conducted based on the protocol established by VIMS (Byles, 1988; Keinath et al., 1987; Keinath, 1993) in the 1980's. Due to inherent biases associated with aerial surveys (glare, sea state, observer differences), we opted to replicate the surveys conducted in 1980's, reducing biases associated with changes in observer efficiency, in order to best compare current turtle densities and estimates to those in the 1980's. The majority of the work associated with this survey was conducted under contract to the Commercial Fishing Advisory Board and supplemented by contract to the Northeast Region of the National Marine Fisheries Service. Surveys were flown in an over-wing aircraft (Cessna XP II) at an altitude of 152 m, and at a speed of 130 km/hr. Approximately 60 transect lines were established over the Chesapeake Bay based on the locations of transect lines used in the 1980's (Figure 3) (Keinath et al., 1987). These lines fall within suitable loggerhead sea turtle habitat: no more than five miles up a tributary and in waters deeper than three meters. Two study regions, the Upper Bay and Lower Bay, were established based on the area surveyed in the 1980's. A total of sixty east-west transects were determined with thirty transects falling within the Lower Bay region and thirty within the Upper Bay region (Figure 3).

Eight lines were randomly chosen for each survey, four within the Upper Bay region and four within the Lower Bay region. These transect lines were flown with the aid of a GPS unit. Surveys were flown once a week during the peak of the stranding season, and bi-weekly during the non-peak period, weather and sea state permitting. Two trained observers, one on each side of the plane, scanned the sea surface for turtles, marine mammals and fishing activity. The time was recorded at the start of each transect line. Each transect took between 12 and 20 minutes to complete. Transect lines flown were spaced far enough apart that the likelihood of a turtle swimming at higher known velocities (3.5 km/hr) counted subsequently within two adjacent transect lines is negligible (Byles, 1988). When an animal or fishing activity was sighted, the following were recorded:

- Sighting angle from the transect line;
- Time and date of observation;
- Species/Activity (and number);
- Weather, sea state; solar glare.

Time at the end of each transect was also recorded. The time that an animal or activity was observed was converted to distance along the transect line through back calculation, determining its location along the transect. The sighting angle, recorded with the use of Suunto inclinometers, was used to determine whether the animal/activity falls within the effective visual swath adjacent to the transect line, abeam of the airplane. The distance each animal/activity was from the transect line was recorded as an angle of degree. GPS units were not used to record the location of objects sighted since the airplane's electronics, located above the observer seats, often disrupted satellite signals and reliable location data were not consistently available.

Byles (1988) and Keinath (1993) estimated population densities using strip transect methodology. This method assumes that all turtles are counted within a given distance from each transect line, and that any turtles falling outside of the census area are not recorded. Both Byles (1988) and Keinath (1993) determined that the effective visual swath within which the peak sighting efficiency occurs is between 50 meters (18º) and 300 meters (63º) from the transect line (Musick et al., 1987). Over 90% of all sea turtle sightings occur within this range (Musick et al., 1984). Thus, the visual swath being surveyed (250 meters on either side of the plane) combined with transect length, allows for the calculation of minimum surface density estimates using line-transect analysis (Byles, 1988; Musick et al., 1987). Minimum sea turtle densities are determined using the following equations (Keinath, 1993):

$$\mathbf{D = N / A} \qquad \text{Eq. 1}$$

where: D = density of sea turtles observed
N = Total number of turtles observed
A = Area surveyed (km^2)

and: $\mathbf{A = (O \times W) \times L}$ Eq. 2

where: O = Number of observers in the plane
W = width of survey area (km) per observer
L = Length of survey transect (km)

or: $\mathbf{D = N / (0.5\ km \times L)}$ Eq. 3

Using radio telemetry data, Byles (1988) determined that loggerhead sea turtles spend approximately 5.3% of their time below the sea surface while resident in the Bay during the summer and fall months. Aerial survey observations only record those animals at the surface or within about one meter of the surface. The minimum density estimates must be multiplied by a correction factor in order to account for turtles below the observed sea surface. The correction factor is determined based on the ratio of time spent below the surface to time at the surface. The ratio used by VIMS for summer and fall estimates is 18.7:1 (turtles below surface to turtles at surface) (Musick et al., 1984; Byles, 1988). Thus, in order estimate the total number of turtles within the flight path, the following equation was applied:

$$\mathbf{D_{corr} = 18.7 \times D} \quad \text{Eq. 4}$$

where: D_{corr} = Turtle density corrected for dive behavior

Densities were then determined for the lower Bay and upper Bay regions by extrapolating the corrected densities to the entire study region:

$$\mathbf{P = D_{corr} \times A_{tot}} \quad \text{Eq. 5}$$

where: P = Estimated turtle population
A_{tot} = Total study area (km^2)

Areas for the Upper Bay and Lower Bay survey area (within the 3 meter depth contour) were calculated from distances and area recorded in ArcView 3.2 (Mercator projection).

RESULTS:

2001 Sea Turtle Strandings:

Managed by the Virginia Institute of Marine Science, the Virginia Sea Turtle Stranding Network has documented high sea turtle mortalities occurring in the spring of each year for the past 23 years. The 2001 stranding season was no exception. In 2001, the first sea turtle stranding was recorded on May 19th. Sea surface temperatures at the mouth of the Bay were approximately 17º C and York River/Bay temperatures were approximately 19º C at that time. A total of 395 sea turtle strandings were recorded for the entire year. This represents the highest annual stranding total in the history of the Virginia Sea Turtle Stranding Network. Ninety-one percent of the 2001 strandings occurred from May to September, with 55% of the 2001 total occurring in the month of June alone. In the last five years, May and June strandings have represented between 50 and 55% of Virginia's annual total, but in 2001, May and June account for 67.1% of the year's strandings. In terms of geographic distribution, 44.6% (176) of the strandings occurred on Bayside of Virginia's Eastern Shore, and the remaining 55.4% were fairly evenly distributed between the other four stranding regions: Western Chesapeake Bay, Southern Chesapeake Bay, Eastern Shore Oceanside and Virginia Beach Oceanside (Figures 4-6). Eighty-four percent (332) of the strandings were loggerheads, and 10.4% (41) were Kemp's ridleys. The remainder of the year's strandings was comprised of seven leatherbacks, three green turtles, and 12 unidentified species (Figure 7).

During the first week of the 2001 spring stranding event (May 19th to 25th), recorded strandings (n = 10) were characterized as "fresh dead" (NMFS Condition Code 1) or "moderately decomposed (NMFS Condition Code 2). During the next week, 71% of the week's strandings (n = 42) were moderately decomposed and approximately 19% of the strandings were "severely decomposed" (NMFS Condition Code 3). By the third (n = 103) and fourth (n = 53) weeks of the stranding event, 62% and 69% respectively, of the weekly strandings were severely decomposed (Figure 8). By week five, the majority of strandings were characterized by NMFS Condition Codes 3, 4 (dried carcass) or 5 (skeleton/bones only). These decomposition states suggest that a large number of the stranded turtles found in the first two weeks of June actually died mid- to late-May (Bellmund et al., 1987) and did not float ashore until upwards of two weeks post-mortem.

Cause of death was not determined for most strandings due to advanced stages of decomposition. At least 34 of sea turtle deaths (8.6% of annual total) were potentially caused by boat strikes (Figure 9). Eleven (2.8%) stranded turtles had ingested or become entangled in fishing gear (excluding poundnets) (Figure 10), and six had puncture wounds resembling those made by a gaff. Ten loggerheads were found entangled in poundnet leaders during routine fisheries surveys in 2001. All turtles were observed within the top two meters of the water column. Nine of these turtles were found in June, one in August. Three of these interactions were observed by stranding cooperatives, and the remaining seven interactions were reported to VIMS by law enforcement/Marine Patrol officers. Only one of the ten turtles was alive at the time of observation. Three turtles were severely decomposed and were determined to have floated in post-mortem. Thus, 1.8% of Virginia's strandings could be directly attributed to poundnet leaders via surface surveys of Bay nets.

Between May 19th through the end of September 2001, whole digestive tracts were acquired from 22 loggerheads and seven Kemp's ridleys for diet analysis. All but one of the samples were obtained from juvenile-sized turtles, and the majority of samples came from the Western Chesapeake Bay, with a few from the Southern Bay, the Bayside of Virginia's Eastern Shore, and the Oceanside of Virginia Beach. Results reveal that 18 of the 22 loggerheads examined in 2001 had consumed fish, while only four had consumed Atlantic horseshoe crabs (*Limulus polyphemus*). Fish comprised over 50% of the total gut content wet weight for 14 of these loggerheads. Over 90% of the total wet weights for all Kemp's ridley samples collected in 2001 consisted of crustaceans, including blue crabs (*Callinectes sapidus*), purse crabs (*Persephona mediterranea*) and spider crabs (*Libinia spp.*). Twenty-three of the 66 loggerheads necropsied by the Virginia Sea Turtle Stranding Network between May and December had fish in their guts, while only one of 23 Kemp's ridleys necropsied during the same period had consumed fish. It should be noted, however, that necropsies and gut samples are limited by decomposition state of the animals, and extremely decomposed individuals are usually not necropsied. The majority of necropsies were performed on animals that stranded in the Western Bay and on the Bayside of the Eastern Shore.

Fisheries Surveys:

Poundnet Characterization:

A total of 72 poundnet stands were observed and monitored between June 1 and October 31, 2001 within the Chesapeake Bay (Figure 11, Appendix A). Of these, 57 were actively fishing pounds (only 55 had active leaders) and 15 were either licensed or unlicensed stands. One of the active nets, located north of Mobjack Bay along the Chesapeake Bay's western shore, was unlicensed. Two additional active stands were located outside the Chesapeake Bay Bridge Tunnel (CBBT), as well as two active stands off Tangier Island, and could not be accessed by boat due to rough seas. The two stands outside the CBBT were located in the vicinity of Lynnhaven, Virginia. These stands were observed in the fall of 2000 and had a latitude and longitude of 36.921 N, -76.065 W and 36.925 N, –76.055 W respectively. In 2000, the leader mesh sizes of these nets were 10 cm (3.9 in) bar or 15 cm (5.9 in) stretch, and 8 cm (3.1 in) or 10 cm (3.9 in) stretch. The Tangier Island stands were observed aerially several times between June and October and were actively fishing the entire time. Fewer licensed poundnets were found in the mainstem Bay during the 2001 season than during the fall of 2000. This is primarily due to the fact that at least one fisherman, with nets located in the York River, retired in 2001.

The majority of poundnet stands (n=40) were located in the Western Bay from Mobjack Bay north to Smith Point and the Maryland border. There were fewer stands within this region than in the fall of 2000 (n=54). No active/licensed stands were located south of Mobjack Bay. Two aerially observed stands were located outside the mainstem Bay region, outside the CBBT within the ocean-stranding region. Since these stands were outside the survey area, they were not observed except by plane. A total of 32 stands were located along the Eastern Shore Bay region, with the main concentration of activity found just north of Kiptopeke State Park south to Fisherman's Island. This represents an increase in stands observed in this area from the fall of 2000 (n=26). No stands were located along the Southern Bay stranding region. The pre-season shoreline survey (May 25, 2001) resulted in no observed poundnets outside the Bay along the Eastern Shore Ocean. Thus, the only areas within Virginia's waters where sea turtles are likely to encounter or interact with poundnets would be along the Western Bay (north of Mobjack Bay), or along the southern portion of the Eastern Shore Bay in the vicinity of Kiptopeke State Park south to Fisherman's Island.

As in the fall of 2000, three types of leaders were observed: mesh leaders, stringer leaders and buoyed leaders. Mesh leaders (n=42) were distributed throughout the Bay, however, buoyed leaders were only found along the Eastern Shore Bay (n=7), located close to shore, with the end of the leaders often extending onshore. The number of buoyed leaders observed was slightly more than the number observed in 2000 (n=5). A total of six string leaders were found only along the Western Bay region, three less than the number observed in 2000 (n=9). Three of the string leaders were located off of

Newpoint Comfort and the northern tip of Mobjack Bay, one just south of the mouth of the Rappahannock River, and two between Reedville and Smith Point near the Maryland border.

When possible, mesh sizes of the leaders were measured. The majority of leaders along the Western Shore (n=31) mesh sizes of 10 cm (3.9 in) bar or less, including some nets with leader mesh sizes of 2.5 cm bar (1.0 in) or 5 cm (2.0 in) stretch. Only one leader had a mesh size between 10 and 15 cm (3.9 in and 5.9 in) bar within this region. This represents a reduction in larger mesh leaders within the Western Bay from the fall of 2000 when seven leaders had mesh sizes between 10 and 15 cm (3.9 in and 5.9 in) bar, and one leader had a mesh size greater than 15 cm (5.9 in) bar. However, compared to 2000, there has been an increase in the smaller mesh sizes (less than 10 cm bar, < 3.9 in) within the Western Bay. Mesh sizes were somewhat larger along the Eastern Shore Bay. Ten leaders had a bar mesh size of 10 cm (< 3.9 in) or less (more than in 2000: n=4), three had mesh sizes between 10 and 15 cm bar (3.9 in and 5.9 in), and three had mesh sizes greater than 15 cm bar (> 5.9 in). Compared to 2000, the total number of mesh sizes greater than 10 cm bar (> 3.9 in) has declined (n=11). The mesh sizes of the pounds and hearts were consistently small throughout the Bay, ranging between two to four cm (0.8 in to 1.6 in) bar.

The only variation in mesh size was among the leaders. This variation is attributed by fishermen to the relative depth at which these nets are set and the strength of the tidal and current flow within that area. Since poundnets extend perpendicularly out from shore, theoretically, the deepest portion of the net should be at the head of the pound. Pound depths for nets set within the Western Bay ranged between 12 feet and 24 feet for mesh sizes less than 10 cm (3.9 in) bar. String leaders set within the Western Bay were found in deeper waters of 16 to 34 feet. Eastern Shore nets with mesh sizes less than 10 cm (< 3.9 in) bar were set in waters between two and 13 feet (0.6 and 4.0 m). Nets with mesh sizes larger than 10 cm bar (> 3.9 in) were sent in waters between 12 and 34 feet (3.7 m to 10.4 m), with the largest mesh sizes (15 cm bar and greater, > 5.9 in) located within the deepest waters (Figure 12).

Gillnet Characterization:

Gillnet harvest and licensing data were obtained from the Virginia Marine Resources Commission (VMRC). Data were analyzed to determine target species and harvest by area between seasons for the Chesapeake Bay. Information regarding gillnet season and regulations may be found in Appendices B and C. Three different types of gillnets are utilized in Virginia's waters: anchored (AGN), drift (DGN), and stake (SGN). Anchored and drift gillnets have the same license. During the 92 gillnet days from May to July 2000, there was a total of 211 harvesters within the Bay and its tributaries in Virginia; during the same period in 2001, there were 182 harvesters. In 2000, 1,751 600-foot AGN and DGN, 1, 469 1,200-foot AGN and DGN, and 129 SGN were sold. As of November 19, 2001, the amount of gear sold during 2001 was similar: 1,722 600-foot AGN and DGN, 1,507 1,200-foot AGN and DGN, and 104 SGN. From May to July 2001, approximately 63.1% of the Virginia gillnet harvest was from AGN, and 36.9% from DGN. SGN harvest represented only 0.02% of the total harvest during this time (Table 1). From August through October 2001, available data reveal that landings were approximately 81.7% AGN, 18.2% DGN, and 0.1% SGN.

The relatively indiscriminant nature of a gillnet makes it possible for many different species to be caught in an individual net, and thus it is difficult to determine the numbers of individual nets targeting specific species (Appendix D). Individual soak times and mesh sizes are not available from VMRC. Targeted species are dependent on mesh size and location, but available landings/harvest data provide a good representation of important species for the Virginia gillnet fishery. Based on pounds landed, monetary value, and numbers of harvest locations, Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), bluefish (*Pomatomus saltatrix*), Atlantic menhaden (*Brevoortia tyrannus*), gray seatrout/weakfish (*Cynoscion regalis*), striped bass (*Morone saxatilis*), and various dogfish and coastal shark species stand out as the important target species from the gillnet fisheries between May and July (Table 1). Available data indicate that Atlantic croaker accounted for 84.2% of the 2,380,017 pounds harvested by gillnet in Virginia from May to July 2001. Spot, the next most harvested species, accounts for only 4.8% of the total harvest during this period. Eighty-nine percent of the large croaker harvest comes from the mainstem Chesapeake Bay, 5.9% from Tangier Sound, and the rest from tributaries, small bays and sounds within Virginia (Figure 13). Seventy-eight percent of the total gillnet harvest from May through July, 2001 came from the mainstem Chesapeake Bay with 8.1% of the total harvested in Tangier Sound (Figure 14). August through October 2001, spot and Atlantic croaker accounted for 54.2% and 37.4% respectively, of the Virginia gillnet harvest (4,282,184 pounds) based on available data. Location of aerially observed gillnet activity is presented with the aerial survey data below.

Side Scan Sonar Survey:

Prior to the sonar surveys, we tested the ability of the sonar to pick up acoustic images of sea turtle carcasses anchored along a poundnet leader in the York River. Ground truthed images indicate that sea turtles as small as 35.0 cm (13.8 in) CCL (Kemp's ridley juvenile) have an acoustic signature within the water column (Plates 5-7). These images, depending upon orientation of the specimen in the water column, could be measured by imaging software within a couple centimeters of the known carapace length. Turtle images could also be differentiated from solid objects, such as poundnet poles/tree branches. The acoustic images of the turtles appeared 'mottled' due to variations in density (bone vs. muscle tissue) within the carcass in comparison to objects of uniform density. The garbage bags scanned did not result in a distinct acoustic signature and could easily be differentiated from the turtle carcasses (Plate 8). The images of other objects scanned (fish, seagrass) were cataloged for visual comparison and reference during subsequent surveys.

Between the dates of June 1 and October 31, 2001, all poundnets with active leaders (n=55) in Virginia's main stem Chesapeake Bay, and approximately five miles up river of the major tributaries, were scanned by sonar. In addition to poundnets located within Virginia's waters, the location of all gillnets within the Bay were determined first by aerial surveys and attempts were made to locate these gillnets by boat after aerial reconnaissance. Due to the size of the Bay and length of time necessary to survey all gear within the Bay, individual surveys were performed in each of these stranding regions, with a concentrated effort during the peak stranding period along the Eastern Shore Bay per the request of the National Marine Fisheries Service This region experienced higher than normal strandings along its beaches between May and early June 2001. Unless depth of water prohibited access, all nets were scanned lengthwise along both sides of the net. Survey efficiency was very high: each net took approximately four minutes per side to scan at a tow speed of 2.0 to 3.5 knots. A baseline image for each active poundnet stand located within the mainstem Chesapeake Bay was recorded and digitally archived. A total of 825 images (baseline and follow-up) were archived of the 55 active poundnet leaders surveyed. For each net, between five and fifteen images were recorded per scan (the number of images archived varied based on length of net). All Bay nets were scanned at least twice, with Eastern Shore Bay nets and southern Western Bay nets observed at least three to four times. Survey frequency depended upon weather, sea state and need based on stranding events. For mesh sizes and the number of nets found within each survey area, please refer to the poundnet characterization listed above.

Scans of Bay poundnets indicated that various species of algae, seagrass and other detritus may imitate the signature of sub-surface sea turtle entanglements (Plates 9-10). The majority of the detritus, however, was found floating along the surface of the nets. In one southern Eastern Shore net, seven juvenile sandbar sharks (*Charcharhinus plumbeus*) were observed entangled within the surface of a leader (Plate 11). These sharks were in waters less than a meter deep and were not picked up by the sonar (towed at one meter depth). Relative mesh sizes and the presence of string leaders could be determined sub-surface through the use of sonar (Plates 9 and 12) as well as the presence of fish within a pound or schooling along a leader. No verified sea turtle acoustic signatures were observed during the baseline or follow-up surveys. This indicates that late season sub-surface entanglements are not probable. In the future, potential sea turtle signatures occurring at depths greater than a few meters below the surface would require sub-surface video surveillance for verification.

Very few gillnets were active in the Bay between June and September (see aerial data). No gillnets were encountered during in-water side scan fisheries surveys. Pre-season sample scans (via 600 kHz Marine Sonics tow fish) of a gillnet were provided by R. Gammish (Plate 13). Since gillnets are not fixed gears and may be subject to tidal and current flows, nets may have a tendency to bunch up, potentially imitating the acoustic signature of an entangled sea turtle (Plate 13). Further, due to legal issues, it is not possible to haul up fishing gillnets to verify the presence/absence of a potential sea turtle acoustic target. It would be necessary to either quantify the signal strength of the return image in order to better identify sea turtle target strength, or utilize a combination of sub-surface video imaging in conjunction with side scan sonar for target verification.

Aerial Monitoring:

Twelve population surveys and one peak season shoreline stranding/fisheries survey were flown between May 25 and October 16, 2001. The shoreline survey was flown along the entire Virginia Bay shoreline and along the Eastern Shore Oceanside to update poundnet location data from the fall of 2000, and to assess gillnet and stranding activity associated with the start of the stranding season. Poundnet location data were combined with in-water surveys and presented above. Gillnet activity was confined to the Eastern Shore ocean side, and several sea turtle strandings were observed along the southern Eastern Shore bayside beaches near Kiptopeke State Park, Sunset Beach and Fisherman's Island. Due to inconsistencies in marking recorded animals, the time needed by stranding cooperatives to access these beaches, as well as the high number of strandings washing ashore, it was not possible to determine whether the strandings observed on this survey were new or previously recorded.

Population surveys began the first week of June and continued weekly, weather permitting, until the end of July. Beginning in August, surveys were flown bi-weekly through October. Only one flight was flown in September due to the Federal Aviation Administration ban on all small aircraft in the lower Chesapeake Bay. This ban was in effect between September 11 and October 1, 2001. Eight transect lines were flown on each survey, with the exception of July 3 when only six lines were flown (four lower Bay, two upper Bay) due to a deterioration in weather and sea conditions. Transect length within the 3m-depth contour ranged between 21.31 km and 50.24 km, with survey area ranging between 10.66 km^2 and 16.18 km^2 per transect. Total survey area for the lower Bay was 626.55 km^2 and 665.36 km^2 for the upper Bay. Estimates of total area for the entire lower and upper Bay regions were determined in ArcView 3.2 to be 1,529.36 km 1,879.41 km^2 and 1,879.41 km^2 respectively (Mercator projection).

Sea turtles were observed on every survey with the exception of the last survey flown on October 16th. Due to early season cold snaps, the last survey most likely corresponded with the period when most sea turtles begin their southern migration out of Virginia's waters (Keinath, 1993). This survey was not included in the analyses. The majority of turtles initially sighted in the spring of the year were located within the lower Bay region (Figures 15-18). As the season progressed, more turtles were sighted within the upper Bay (Figures 19-25). Apparent abundances steadily declined after August.

Most turtles observed were found between 50 and 300 to 350 meters from the transect line (Figure 26). Turtles falling outside this range (n=2) were eliminated from the analyses. Minimum estimated sea turtle densities (uncorrected for diving behavior) were greatest in June (0.147 turtles/km^2 +/- 0.022 turtles/km^2 standard deviation) and declined over the course of the season within the lower Bay (Figure 27). Per survey, these densities ranged from 0.019 turtles/km^2 (+/- 0.038 turtles/km^2) in October to 0.181 turtles/km^2 (+/- 0.107 turtles/km^2) in June (Table 2). Upper Bay densities (per survey) ranged from 0.00 turtles/km^2 in October to 0.154 turtles/km^2 in the first half of June (Table 2). Highest average densities observed in the upper Bay during June (0.080 turtles/km^2 +/- 0.054 turtles/km^2), with declining densities in July (0.021 turtles/km^2 +/- 0.027 turtles/km^2), a secondary peak in August (0.044 turtles/km^2 +/- 0.041 turtles/km^2) and declines in September (0.012 turtles/km^2 +/- 0.024 turtles/km^2) and October (0.00 turtles/km^2) (Figure 27). Based on negative biases associated with strip-transect analyses and sea turtle sightability, these density estimates must be considered as minimum estimates.

Extrapolated population estimates factoring in area surveyed and turtle surfacing behavior were calculated for the purposes of comparison with aerial survey work from the 1980's. Variance associated with the surfacing behavior correction factor is not apparent from available literature. As part of VIMS' future research, these estimates will be recalculated to include descriptive statistics, and incorporate radio tracking data from the 2002 season including a quantification of seasonal surfacing patterns. Thus, for the purposes of this study, our extrapolated population estimates may only serve as a relative index of abundance in relation to the work presented in the 1980's. The Lower Bay population estimates, behaviorally corrected for densities and spatially extrapolated, ranged between 549 turtles in early October, to 5,169 turtles the second week of June (Table 2). Upper Bay estimates, excluding October and July 3, ranged between 418 and 5,404 turtles (Table 2). Population estimates were highest in June and early July, declining in August, September and October (Figure 28).

Surveys conducted by VIMS in the mid-1980's were concentrated within the lower Bay. 2001 surveys recorded a total of 63 turtles over time within an observed area of 626.6 km^2, resulting in an unadjusted average density of 0.100 turtles/km^2. With the behavioral adjustment, this is increased to an average of 1.873 turtles/km^2, resulting in an extrapolated average population estimate of 2,865 turtle over the course of the entire season (Table 2). The lower Bay area surveyed in 2001 was also larger than that surveyed in the mid-1980's by approximately 146 km^2. Mean population estimates between 1982 through 1985 and 1994 ranged between 3,068 turtles to 9,743 turtles in the lower Bay (Table 3). These surveys began early to mid-May. Due to inclement weather, the first surveys in 2001 did not commence until early June and it is possible that peak abundances were missed, thereby reducing our overall estimates.

Gillnet activities were insignificant during the months of June and July and did not increase significantly until October. No data are available, however for mid- to late-September due to airspace closures over the southern Chesapeake Bay. Gillnetting activities that were observed during transect surveys occurred within the northern transects of the lower Bay region, or within the upper Bay (Figures 15-25, 29). No more than one to four nets were observed per survey within the defined survey strip. Menhaden boats were also observed primarily within the upper Bay region, however no more than four boats were observed during any given survey (Figures 15-25, 30-31). Crab pots were observed throughout the Bay, blanketing Bay shorelines out to a depth of approximately ten meters. Due to the density of crab pots within the Bay, it was not possible to record every single pot within the strip transect. Distances of crab pot densities from or to shore were back calculated from the time of observation of the last pots from shore, or first observed pots heading to shore along each transect flown (Appendix E). The distribution of crab pots in the Bay generally complied with the newly established Marine Protected Area and Corridor (MPAC) for the Bay's blue crab spawning stock, or "crab sanctuary" (Figure 32). Recreational and commercial fishing boats were also observed throughout the Bay. Recreational fishing vessels were predominantly hook and line fishers and were often found in association with converging water masses/fronts. Commercial fishing boats, not including menhaden boats, were primarily comprised of crabbers (Appendix E) and located mostly outside the "crab sanctuary", within the 10-meter depth contour of the Bay (Figure 32). Most commercial vessels were observed later in the summer—from mid-July through August (Figures 30-31).

Marine mammals were also observed during surveys. All mammals observed were a species of dolphin, most likely the bottlenose (*Tursiops truncatus*). Distribution of mammal sightings is provided in Figures 15-25. Most mammals were sighted during the first half of the summer and in highest concentrations in the lower Bay region. Mammal sightings ranged from one individual up to a group of five or more. Appendix F provides counts of marine mammals per sighting.

DISCUSSION:

Strandings:

The 2001 stranding season recorded the largest number of confirmed sea turtle strandings (395) since the inception of the Virginia Sea Turtle Stranding Network in 1979. However, the overall pattern of strandings is similar to years past. Virginia sea turtle strandings typically show a large spring peak sometime from mid-May to June, after which strandings drop off to a low level for the rest of the summer (Lutcavage, 1981; Lutcavage and Musick, 1985; Keinath et al., 1987; Coles, 1999). The timing of the 2001 peak (late-May to mid-June) is consistent with years past, though much larger in magnitude. A small fall peak, consisting primarily of Kemp's ridleys typically occurs as the turtles leave the Bay for warmer waters (Lutcavage and Musick, 1985; Coles, 1999). Such a peak was seen during the fall of 2001. A total of 31 strandings were reported between September 29 and November 19, 2001. Eight (25.8%) of these strandings were Kemp's ridleys, representing 19.5% of this species' strandings for the whole year.

In the last five years, May and June strandings have represented between 50% and 55% of Virginia's annual total. In 2001, however, May and June account for 67.1% of the year's strandings. Over half of the May and June strandings were found on the Eastern Shore Bayside. This increase may be due to a number of factors, including increased stranding network coverage of Eastern Shore beaches in 2001, a potentially new or larger source of sea turtle mortality (natural or human induced), or a larger than normal number of turtles found in association with an existing source of mortality. The decomposition states of the turtles, progressing from fresh and moderately decomposed animals to more and more severely decomposed animals, were consistent with patterns seen for the 1999 and 2000 strandings (VIMS, unpub. data). These decomposition data indicate that many of the turtles stranding during seasonal stranding peaks may actually be dying one or more weeks prior to washing ashore and may help in pinpointing a reasonable timeframe for management strategies to be implemented.

After preliminary reports of 160 sea turtle strandings in Virginia from May 19 to June 11, 2001,the National Marine Fisheries Service, enacted a temporary rule requiring Virginia watermen fishing poundnets "with leaders measuring 8 inches (20.3 cm) or greater stretched mesh and leaders with stringers to tie up such leaders in the Virginia waters of the Chesapeake Bay and tributaries for a period of 30 days" (NMFS, 2001). The regulation was in effect from June 19 through July 19, 2001. A total of 62 turtles stranded during the closing. Historic stranding data suggest that the stranding peak was already near its end by June 19, and 2001 stranding counts declined following similar trends. Additionally, Bellmund et al. (1987) determined that only those leaders with stringers and those with "large mesh" (in excess of 12 to 16 inches stretched mesh) posed a threat for turtles entering the Bay after the spring migration. The numbers of poundnets have declined drastically since the 1987 report, and only a handful of nets with large mesh and stringer leaders are currently fished in the Bay (Mansfield et al., 2001). Therefore, the threat to sea turtles and economic impacts to the poundnet fishery were not minimized based on the timing and mesh sizes regulations of the emergency closure.

Post-mortem analyses:

Characterizing and quantifying the digestive tract contents of stranded loggerhead and Kemp's ridley should help provide a clearer picture of these species' diets and current roles in the food webs of the Chesapeake Bay and Virginia continental shelf. Gut content analyses may also provide insight to indirect and direct effects of Virginia's fisheries on sea turtles. The Atlantic horseshoe crab and the blue crab were reported as the most common prey of loggerheads and Kemp's ridleys, respectively, in Virginia from 1979 to 1984 (Bellmund et al., 1987; Lutcavage and Musick, 1985; Musick et al., 1984). However, few gut samples have been quantified since then, and Virginia's horseshoe crab (ASMFC, 1998; Fisher, 2000) and blue crab populations (Lipcius and Stockhausen, In press) have both experienced declines. If these declines are severe enough, turtles may be forced to turn to other food sources, either by switching to other invertebrate prey or by interacting with fisheries. It is believed that turtles are typically "not agile enough to capture fish under natural conditions" (Bellmund et al., 1987), and thus would only consume large quantities of finfish by interacting with fishing gear (Bellmund et al., 1987) or bycatch (Shoop and Ruckdechel, 1982).

Although the loggerhead sample size was small in 2001 (66 necropsies, of which 22 guts were sampled), the gut content data show that a large percentage of loggerhead guts examined contained fish (35% of necropsies, n=23; 64% of samples, n=18). This may indicate that loggerheads have responded to recent horseshoe crab declines by interacting more with fisheries, either by feeding on bycatch or by feeding directly from nets. Such a diet shift could have deleterious effects if it increases the risk of boat strikes or entanglement. However, it is important to clarify that the presence of fish within the gut of a stranded sea turtle does not confirm a fishery-related death—it merely shows that the turtle consumed fish at some point within at least a week prior to death. Burke et al. (1994) determined that evacuation rates of two small benthic-stage juvenile ridleys took upwards of seven and eight days. Many of the fish parts observed in the 18 loggerhead gut samples examined were disarticulated bones in the later stages of digestion.

The Kemp's ridleys examined in 2001 had consumed primarily crustaceans, including blue crabs, which might indicate that blue crabs are still sufficiently abundant to support the small ridley population of Virginia. It should be noted, however, that necropsies and gut samples are limited by decomposition state of the animals, and extremely decomposed individuals are usually not necropsied. Thus, only a fraction of the turtles washing ashore were examined, with the majority of the examinations occurring within the western Bay, north of the James River. Field necropsies generally entail opening the turtles' abdominal cavity, noting the presence of fat reserves and gut contents. Only cursory observations are recorded in reference to the health of these animals. As such, these necropsy data cannot rule out the possibility of health-related issues in the sea turtle mortalities occurring in Virginia. Future diet analyses will help provide a clearer picture of current loggerhead and Kemp's ridley diet preferences and ecology.

Fisheries Surveys:

It is important to place the poundnet fishery into historical perspective when attempting to assess its impact on sea turtles. In the early 1980's when VIMS was contracted to study poundnet-turtle interactions, there were over three hundred active poundnets in the Virginia mainstem of the Chesapeake Bay. This study concluded that between 3% and 33% of the sea turtle mortalities in Virginia could be attributed to large mesh (>12" stretch) leaders within the mainstem Bay. A combined total of 211 poundnets were observed in 1983 (n=113) and 1984 (n=98) within the Western Chesapeake Bay alone (Bellmund et al., 1987). Between these years, 173 of the nets examined were large mesh nets (defined by Bellmund et al. [1987] as > 12 inch stretch) and 38 had string leaders (Bellmund et al., 1987). Based on the 2000 and 2001 poundnet surveys, the current number of poundnet stands found in the mainstem Bay (Virginia waters) ranges between 70 and 80 stands, with even fewer active at any given time. During the 2000 and 2001 seasons, there were approximately 20 large mesh nets (> 12 in stretch) in the entire mainstem Bay—a drastically reduced number of large mesh nets compared to the 1980's. Yet, VIMS has recorded a steady increase in sea turtle mortalities in Virginia over the past eight to ten years.

During the 2001 season a total of ten turtles (out of 395 strandings) were observed to have had some form of interaction with a poundnet leader. Only one of these turtles was alive and observed entangled within a large mesh (>12" stretch) leader off the Eastern Shore (bayside). The remaining nine turtles were found in leaders during patrols performed by Virginia Department of Game and Inland Fisheries observers. Most of these animals were severely decomposed, and in at least three instances, it was determined by the observer that the carcasses most likely had floated in post-mortem. It takes upwards of two weeks in a marine environment before an average juvenile sea turtle becomes severely decomposed. A NMFS funded study performed by VIMS in 1984 monitored the condition of five sea turtles found to have recently died within poundnet leaders. These turtles were examined regularly over a five-week period and the rate of decomposition was observed. "None of the turtles monitored became disentangled by natural causes…therefore it is not probable that stranded turtles with no visible marks or [of] unknown cause of death…were killed by poundnets" (Bellmund et al., 1987). Ideally, daily patrols of poundnet leaders within targeted stranding areas should be performed in order to best assess actual entanglement rates. Communication between VIMS, NMFS observers and Marine Patrol should also be strengthened in order to establish a timeline of observations and net visits. This would allow for a better assessment of how long a turtle may have been entangled in a given net based on its stage of decomposition.

Few if any gillnets were observed within the Chesapeake Bay during the peak stranding weeks. Of those observed, most were located within the upper Bay regions during the peak of the stranding season. Not until the fall were gillnets regularly observed within the lower Bay region, and even then, were few in number. However, it is possible that gillnets are being fished at times not coinciding with the aerial and in-water surveys. The sink/drop gillnet fishery, a type of anchored gillnet (AGN), is known to fish in the early morning hours (3am to 7am) and therefore not likely to be observed during aerial surveys (10am to 3pm)(R. O'Reilly, pers. comm.). This fishery may best be monitored via state or federal observers. More information is also needed on turtle interactions occurring within ocean-based gillnet activities, both within state and federal waters.

Side scan sonar surveys have strong potential in assessing sub-surface entanglements of sea turtles within fixed gear fisheries. Though these surveys provide a relatively efficient way to observe for sub-surface entanglements, they are limited by weather and sea conditions and on the ability to verify object signatures within the nets. Successful surveys occurred when the sea state was relatively calm since suspended sediments (due to wave turbulence) are reflected acoustically by the sonar. Surveys are also targeting sea turtles that have become entangled within a net somewhere within the water column—above the seabed. As such, a quantifiable acoustic signature may be difficult to obtain since target strength may change based on the orientation of a turtle within a net. Side scan sonar works on the principals of sound reflection. The tow fish transmits a sound into the water column and detects objects based on the echoes that are returned/reflected (Kasul and Disckerson, 1993). The strongest returns/reflections are received from objects containing air/gas pockets (Kasul and Dickerson, 1993) and dense structures such as bone. Thus, decomposition and bloat of an entangled turtle may also define the type of signature returned. Future side scan sonar studies should include cataloging signatures of turtles based on size, species, orientation and decomposition stage. The use of sub-surface video surveillance as a means of target identification should also be employed for potential targets found below the first few meters of water. Ideally, daily patrols of poundnet leaders within targeted stranding regions should also be performed in order to best assess actual surface entanglement rates.

Aerial Surveys:

In the process of establishing reasonable take limits per fishery in Virginia, it is imperative that existing sea turtle stocks be fully understood. Strip transect methods risk negative bias in density calculations since this method assumes that all animals are seen and recorded within the survey strip. Turtles observed just outside the study swath must also be eliminated from the analysis. Thus, strip transect methods may only provide minimum density and population estimates. Management-wise, underestimating the endangered/threatened turtle sub-population in Virginia is less detrimental than overestimating the population. Future VIMS research will include both strip and line transect methodology applied to densities from the 1980's and present. Estimates and surfacing times of sea turtles from the 1980's will also be recalculated to include descriptive statistics, and incorporate radio tracking data from the 2002-2003, season including a quantification of seasonal surfacing patterns.

The distribution of sea turtles over time in 2001 was consistent with the distribution of sea turtles observed during previous VIMS turtle surveys. The highest number of turtles observed were within the spring months and located within the lower Bay, corresponding to the time when turtles are first migrating into Virginia's waters. These higher numbers may be associated with a) a concentration of turtles moving into the Bay during the initial weeks of their residency period, after which they are found more evenly distributed within the upper and lower Bay; b) differences in surfacing behaviors in the spring months vs. warmer summer moths; and/or c) some turtles entering into the Bay as a stop-over place to feed along their migration route to northern summer foraging habitats. Regardless, most turtles observed during the early part of the residency season are found in the lower Bay. Most strandings also initially occur within the lower Bay region during this timeframe. Fishery-based management strategies should prioritize the lower Bay fisheries over upper Bay fisheries in the early spring.

Aerial population surveys only record sea turtles visible at the surface of the water, requiring that a correction factor be applied to turtle observations in order to estimate population densities. The distribution, biology and behavior of sea turtles are strongly linked to the thermal regimes of a turtle's environment (Spotila et al., 1997). Byles' radio and sonic tracking work in the 1980's indicate that sea turtles spend approximately five percent of their time at the surface while foraging in the Bay during the summer months (Byles, 1988). However, surfacing behavior may vary with season (Keinath, 1993), particularly early in the springtime when sea temperatures are lower and waters are more stratified. To improve estimates of regional abundance from surface densities, more data are also needed on the amount of time turtles are visible on the sea surface throughout their residency in Virginia waters—particularly during the spring season. Determining whether sea turtles exhibit a difference in their inter-seasonal diving behaviors will help determine their vulnerability to different fishing/commercial gears, affecting incidental takes of turtles in near-shore fisheries. Dive behavior and surfacing times have not been determined for turtles present in the Bay during spring months. Aerial correction factors for surfacing behavior were also calculated only for loggerhead sea turtles—potentially biasing population estimates that would include Kemp's ridleys (previous aerial surveys did not distinguish between species). Radio tracking conducted by VIMS in the spring of 2002-2003 will help determine the correction factor necessary for turtle densities calculated seasonally and by species.

In comparing aerial survey data to data collected during 2001, it is important to note that 2001 surveys did not begin until after the stranding season had begun, due to available funding and inclement weather conditions. It is possible that we may have missed the peak week in relative turtle abundances and our data should be considered a minimum estimate of turtles found within the Chesapeake Bay in 2001. Surveys should be conducted again in 2002 in order to assess inter-seasonal variability. These surveys should also begin in May (weather permitting) in order to observe turtles as they move into the Bay and to better estimate abundances relative to those estimated in the mid-1980's.

Proposed Management Strategies:

On September 12, 2001 a list of management strategies were agreed upon by Virginia fishermen, VMRC and VIMS. It was discussed that the large mesh leaders (>12" stretch) be dropped within the water column during the critical time when turtles are first migrating into the Bay. The justification for dropping leaders to nine feet below the water's surface is based on observations of poundnet leaders by VIMS over the course of 22 years. This research was conducted by vessel and by scuba divers, and suggests that turtle-leader interactions occur most frequently within the upper water column (1-2 meters) (Musick et al., 1984). The diving behavior of sea turtles in the Chesapeake Bay in late May and early June may explain this pattern. The thermocline at this time of year is still steep with surface temperatures ranging between 18º to 24º C and bottom temperatures between 10º and 14º C. These conditions may limit the turtles' preferred habitat to the upper part of the thermocline. As the Bay heats in June and bottom temperatures warm up, loggerheads move onto their preferred foraging areas on the bottom of tidal channels (Byles, 1988). This may explain the large drop in entanglements in late June and beyond. VIMS side scan sonar surveys of poundnet leaders during the summer of 2001 also support the contention that sub-surface entanglements are rare since no potential sea turtle acoustic signatures were observed during surveys conducted after the season's stranding peak. Additionally, one of the gear modifications discussed at the VMRC sea turtle taskforce meetings included widening the gap between the strings composing the string leaders to three feet (36"). This should allow sea turtles to pass relatively unobstructed through the string leaders. The modification proposed would create 3'x 9' openings in the top of the net.

Timing is crucial for any turtle management strategy with the goal of reducing turtle-fisheries interactions in Virginia. Historic stranding data combined with sea temperature data (Coles, 1999) and carcass condition codes all indicate that the critical time for sea turtle strandings in Virginia's waters is between mid-May and mid-June. Yearly variability associated with the start of the stranding season has been related to differences in sea temperatures (Coles, 1999). Thus, gear modifications, regulations or closures—regardless of the fishery, should be implemented much sooner than mid to late June. In addition, ocean-based and offshore sources of mortality must also be identified and quantified during this timeframe. More information is needed regarding prevailing currents and transport systems in the spring of the year that may carry turtle carcasses into the southern Chesapeake Bay from points offshore.

Finally, in the process of establishing reasonable take limits per fishery in Virginia, it is imperative that existing sea turtle stocks be fully understood. The distribution, biology and behavior of sea turtles are strongly linked to the thermal regimes of a turtle's environment (Spotila et al., 1997). Byles' radio and sonic tracking work in the 1980's indicate that sea turtles spend approximately five percent of their time at the surface while foraging in the Bay during the summer months (Byles, 1988). However, surfacing behavior may vary with season (Keinath, 1993), particularly early in the springtime when sea temperatures are lower and waters are more stratified. To improve estimates of regional abundance from surface densities, more data are also needed on the amount of time turtles are visible on the sea surface throughout their residency in Virginia waters—particularly during the spring season. Determining whether sea turtles exhibit a difference in their inter-seasonal diving behaviors will help determine their vulnerability to different fishing/commercial gears, affecting incidental takes of turtles in near-shore fisheries.

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TABLES

TABLE 1. Chesapeake Bay gillnet landings (pounds) of major fish species by net type, May through July, 2001. Data courtesy of VMRC and based on data available at time of writing.

	Anchored	Drift	Stake	All Nets
Atlantic Croaker	1,172,836	830,249	0	2,003,085
Spot	84,566	29,677	21	114,264
Bluefish	68,949	11,742	45	80,736
Atlantic Menhaden	40,035	290	0	40,325
Gray Seatrout	29,292	2,636	4	31,932
Striped Bass	6,860	509	0	7,369
Other Species	99,987	1,990	329	102,306
Total harvest	1,502,525	877,093	399	2,380,017

TABLE 2. Summary of 2001 Aerial Surveys by Flight

Date	Portion of Bay	No. of Transects	Area Observed (km^2)	Average Area per Transect (km^2)	No. of Turtles Observed	Average Turtle Density	St.Dev. of Density	Average Population Estimate
8-Jun	Lower	4	58.33	14.583	8	0.135	0.074	3,875
8-Jun	Upper	1	18.00	18.000	1	0.056	--	1,952
12-Jun	Lower	4	59.36	14.840	10	0.181	0.107	5,169
12-Jun	Upper	4	68.67	17.168	9	0.154	0.136	5,404
19-Jun	Lower	4	57.85	14.463	8	0.137	0.126	3,913
19-Jun	Upper	4	65.04	16.260	2	0.027	0.031	932
26-Jun	Lower	4	58.73	14.683	8	0.135	0.044	3,862
26-Jun	Upper	4	63.15	15.788	5	0.082	0.095	2,890
3-Jul	Lower	4	51.63	12.908	2	0.036	0.041	1,022
3-Jul	Upper	2	25.02	12.510	0	0.000	0.028	0
10-Jul	Lower	4	54.70	13.675	9	0.163	0.083	4,662
10-Jul	Upper	4	68.51	17.128	2	0.030	0.103	1,039
17-Jul	Lower	4	51.69	12.923	3	0.054	0.071	1,558
17-Jul	Upper	4	76.65	19.163	4	0.052	0.082	1,817
7-Aug	Lower	4	60.54	15.135	4	0.064	0.096	1,839
7-Aug	Upper	4	71.59	17.898	7	0.098	0.029	3,442
28-Aug	Lower	4	57.15	14.288	6	0.108	0.092	3,101
28-Aug	Upper	4	69.39	17.348	1	0.014	0.024	508
6-Sep	Lower	4	58.17	14.543	4	0.069	0.097	1,962
6-Sep	Upper	4	72.63	18.158	1	0.012	0.000	418
2-Oct	Lower	4	58.40	14.600	1	0.019	0.038	549
2-Oct	Upper	4	66.71	16.678	0	0.000	0.053	0
All	Lower	44	626.55	14.240	63	0.100	0.079	2,865
All	Upper	39	665.36	17.060	32	0.052	0.058	1,673

TABLE 3. **Lower Bay Aerial Surveys, Sea Turtle Densities and Population Estimates by Year (strip transect methodology).**

Year	No. of Flights	No. of Turtles	Area Observed (km^2)	Unadjusted Density (turtles/km^2)	Behaviorally Adjusted Density	Population Estimate
1982	10	168	632	0.266	5.001	6,862
1983	12	272	721	0.377	7.088	9,743
1984	10	207	629	0.329	6.185	8,490
1985	11	176	699	0.252	4.738	6,526
1994	8	58	492	0.118	2.218	3,068
Mean	10.200	176.200	634.600	0.268	5.046	6,938
St. Dev.	1.483	77.725	89.422	0.098	1.841	2,521

Data compiled from Byles, 1988; Keinath, 1993; and Keinath et al., 1994.

Each population estimate is based on the survey area for a given year, which was 1,383 km^2 during 1982 - 1985.

FIGURES

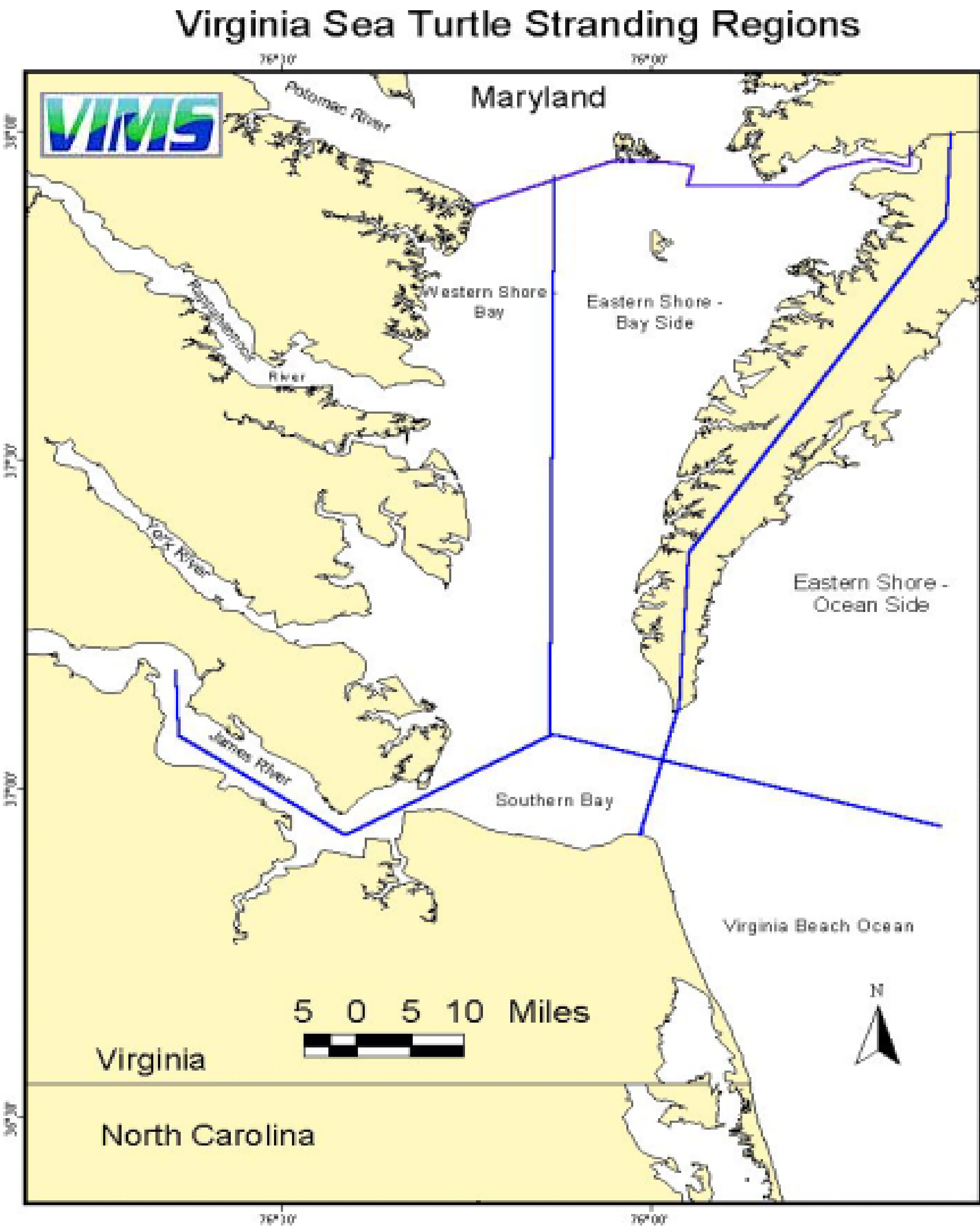


Figure 1. Sea turtle stranding regions (from Mansfield et al., 2001).

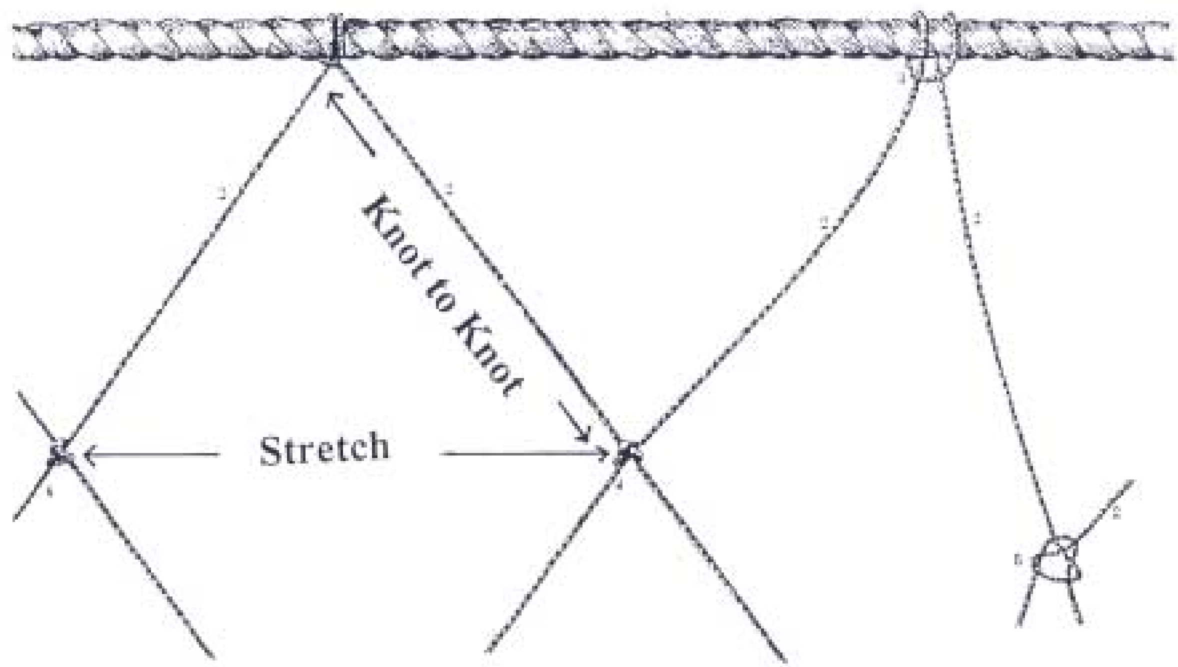


Figure 2. Mesh size measurements (knot-to-knot and stretch) for poundnet leaders (from Mansfield et al., 2001).

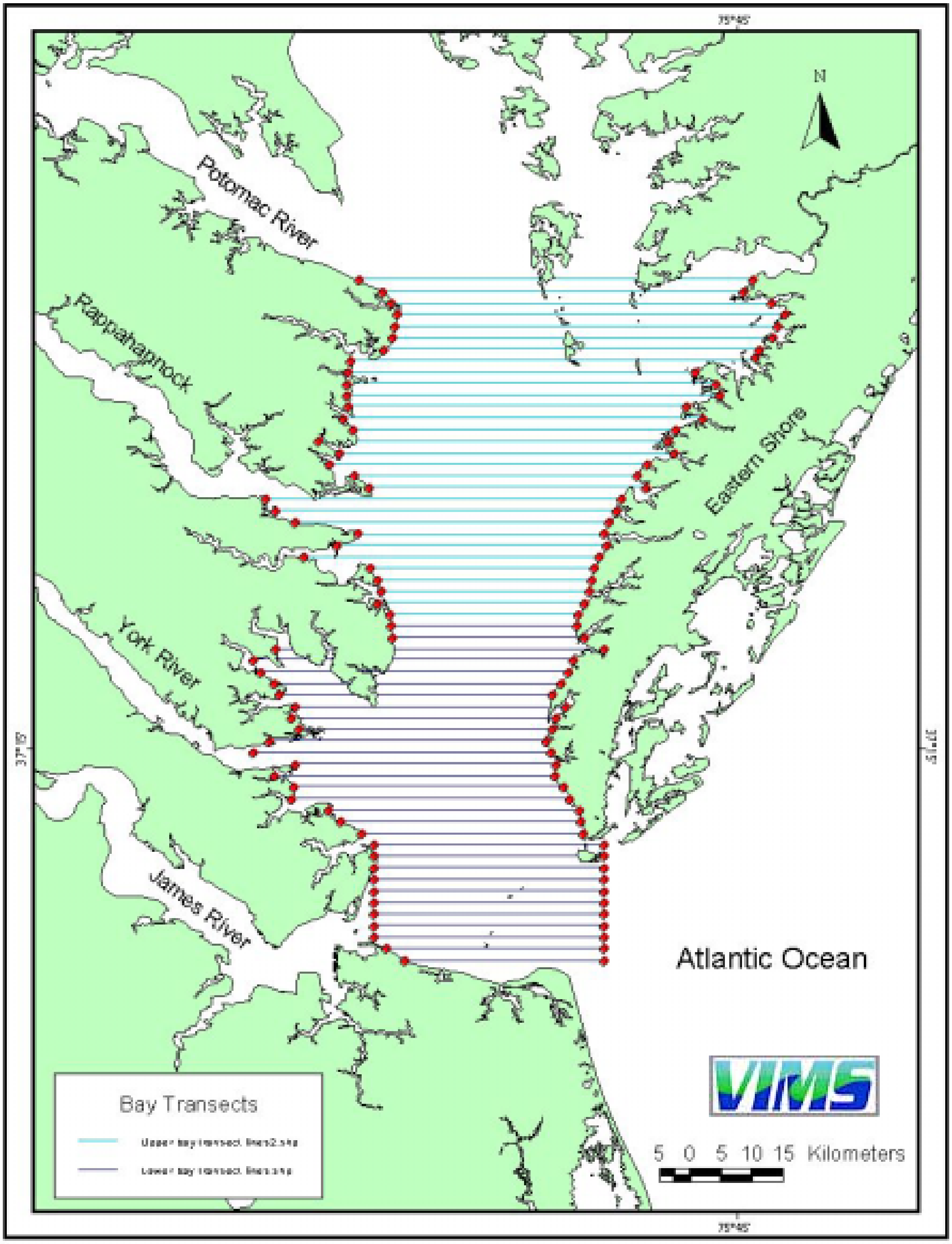


Figure 3. Transect locations (including Upper and Lower Bay survey areas) for the Chesapeake Bay aerial surveys, 2001.

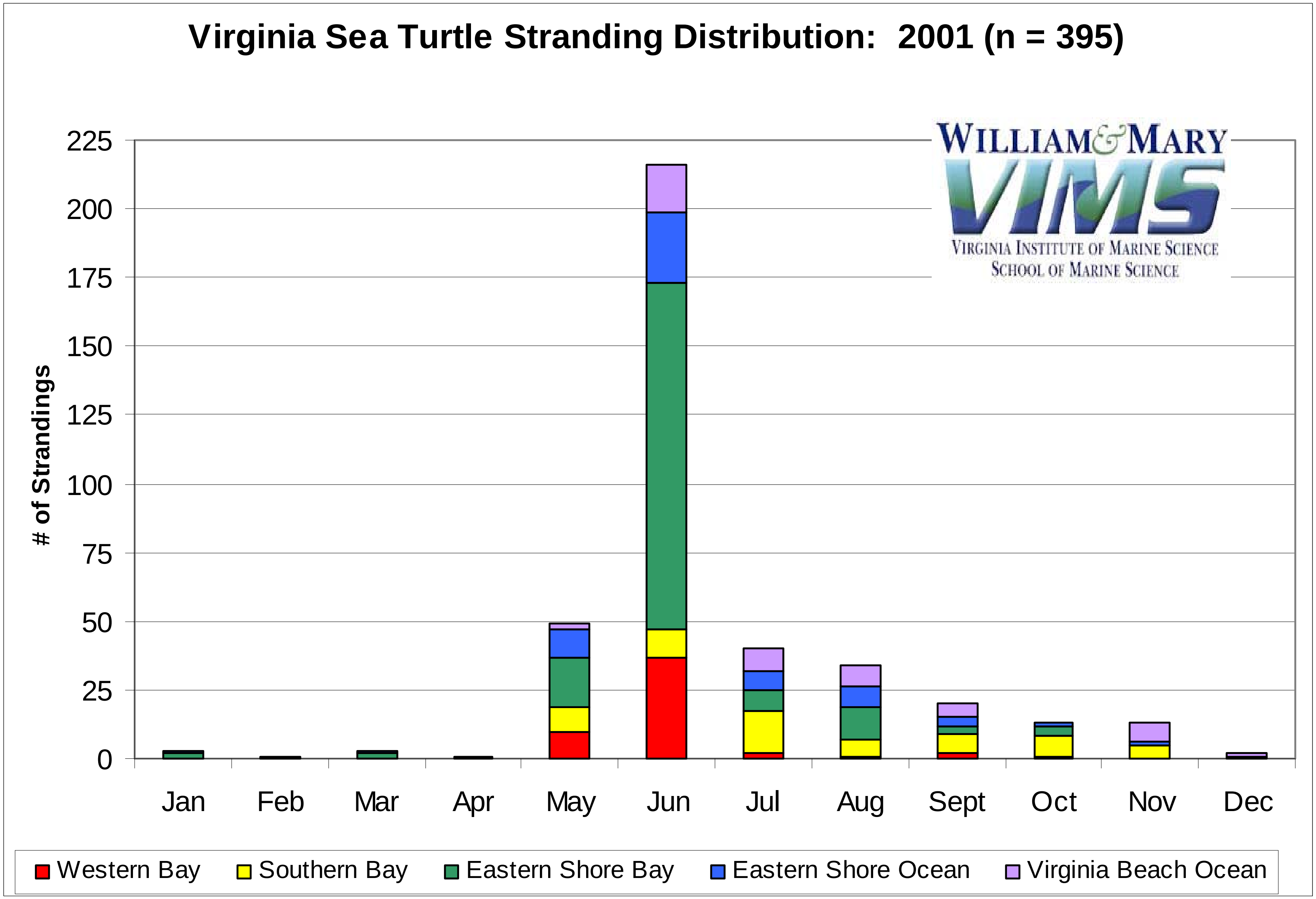


Figure 4. 2001 Virginia sea turtle strandings by month and stranding region.

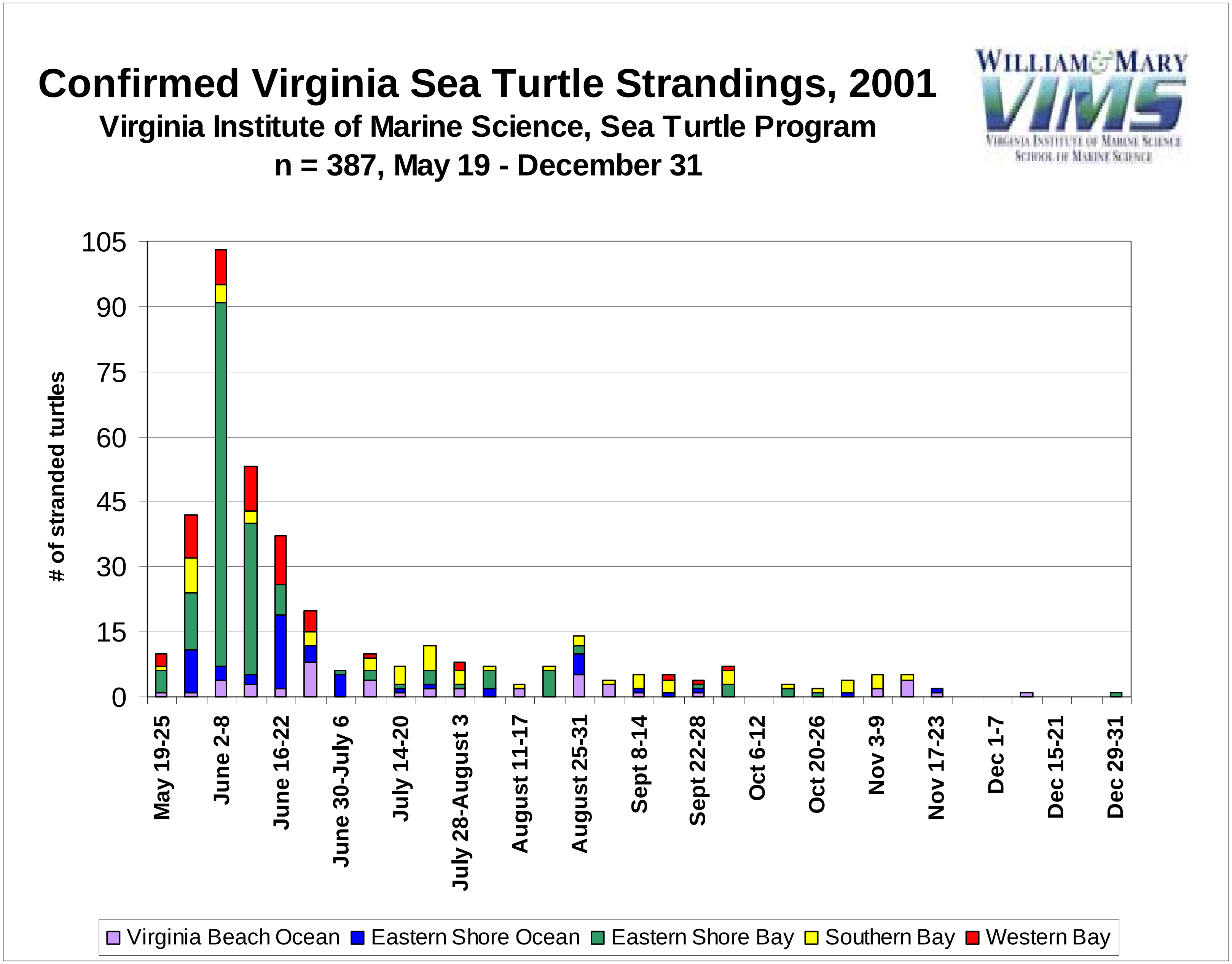


Figure 5. May through December 2001 sea turtle strandings by week and stranding region.

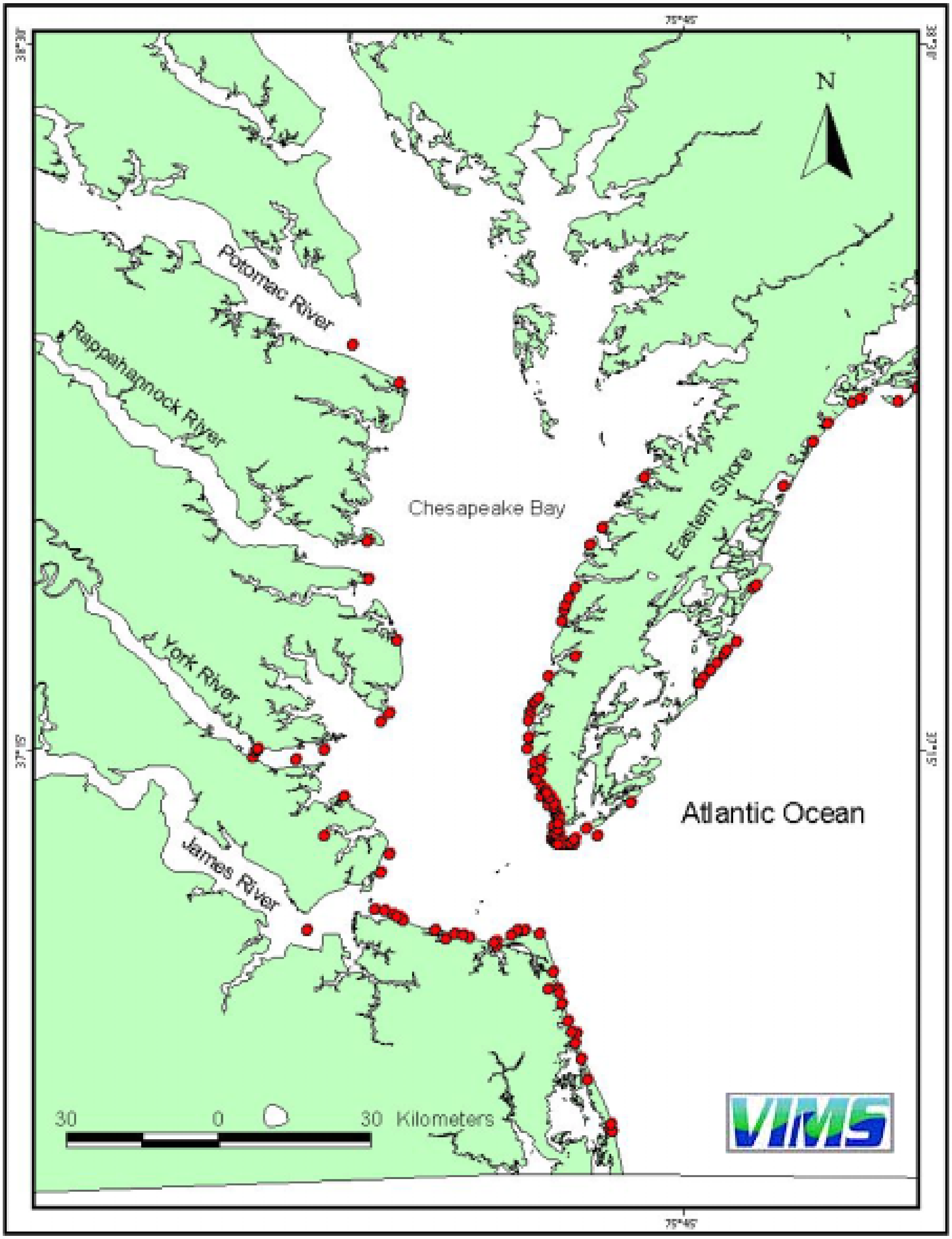


Figure 6. Locations of sea turtle strandings in Virginia, May through December, 2001.

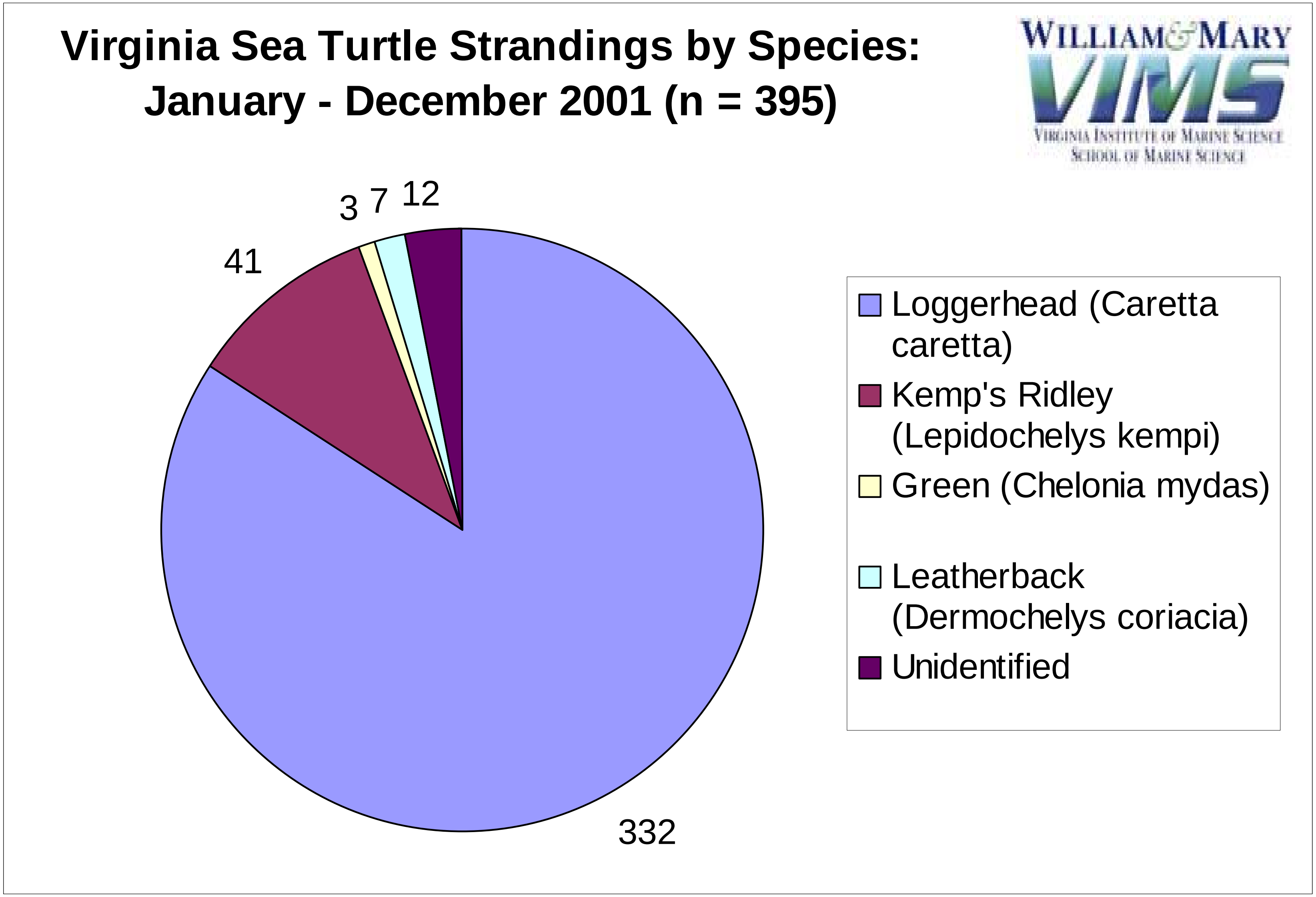


Figure 7. 2001 Virginia sea turtle strandings by species (January-December).

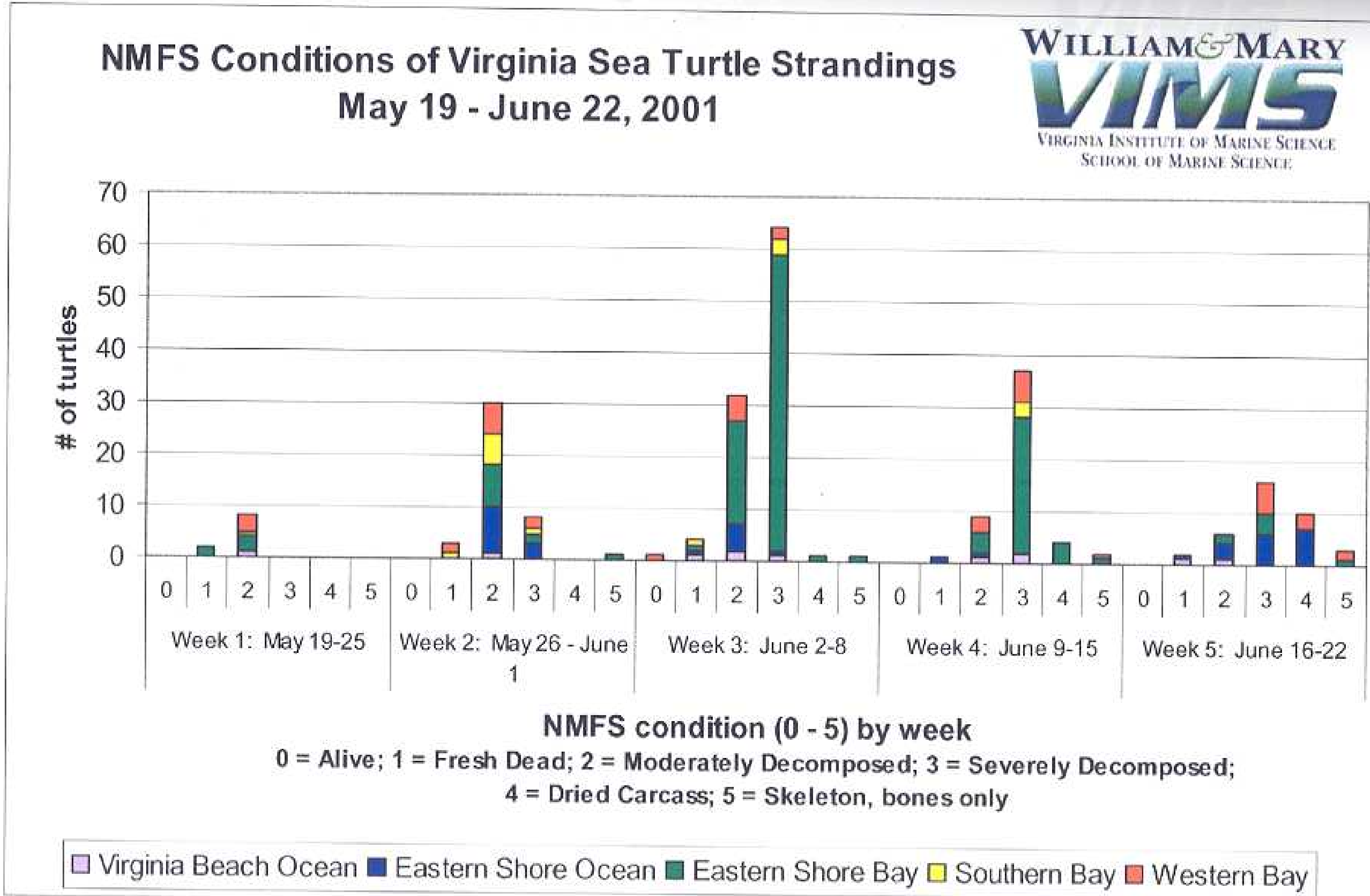


Figure 8. Weekly National Marine Fisheries Service carcass conditions of Virginia sea turtle strandings, May 19 through June 22, 2001.

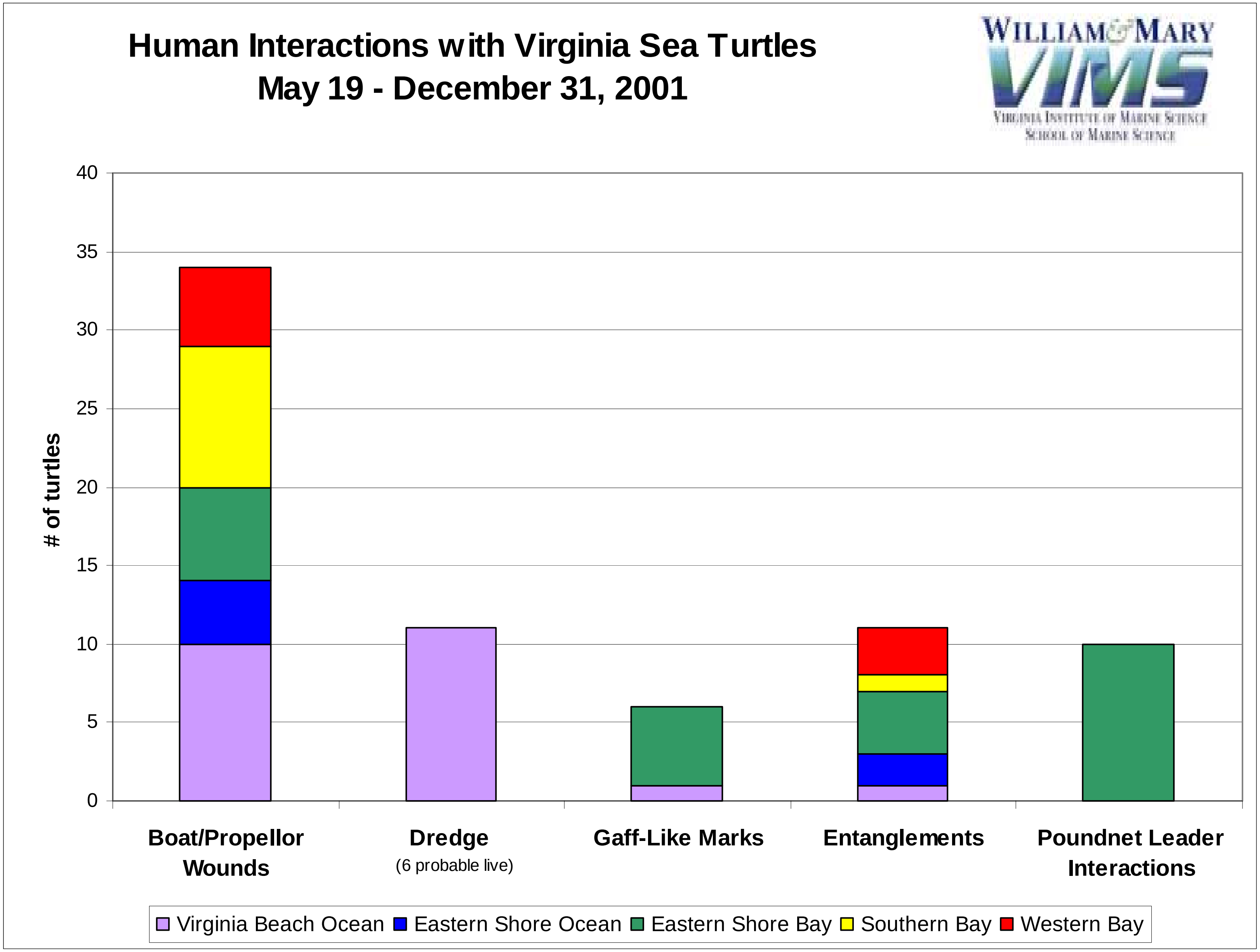


Figure 9. Sea turtle-human interactions of Virginia strandings, May-December, 2001.

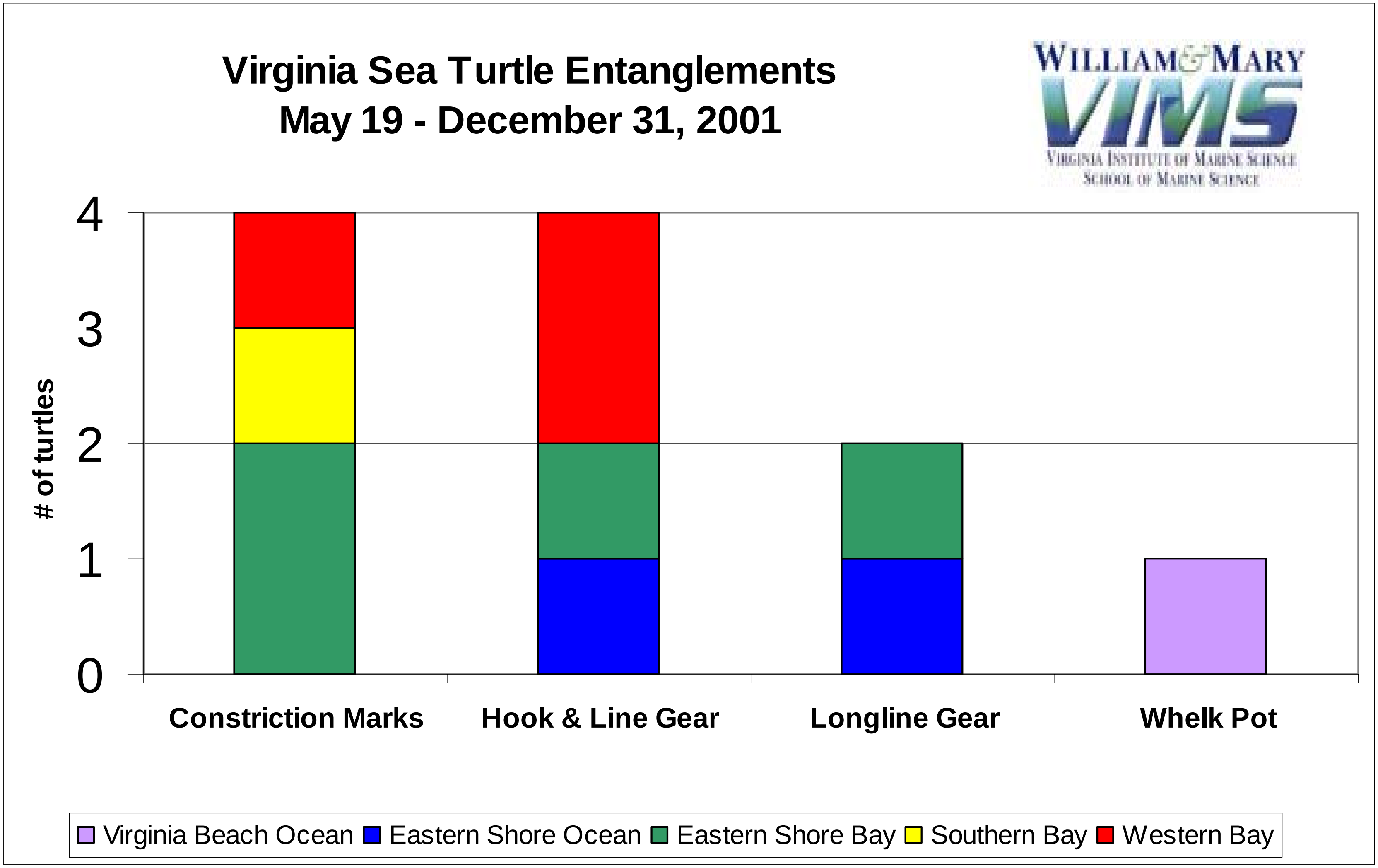


Figure 10. Virginia sea turtle entanglements, May-December, 2001.

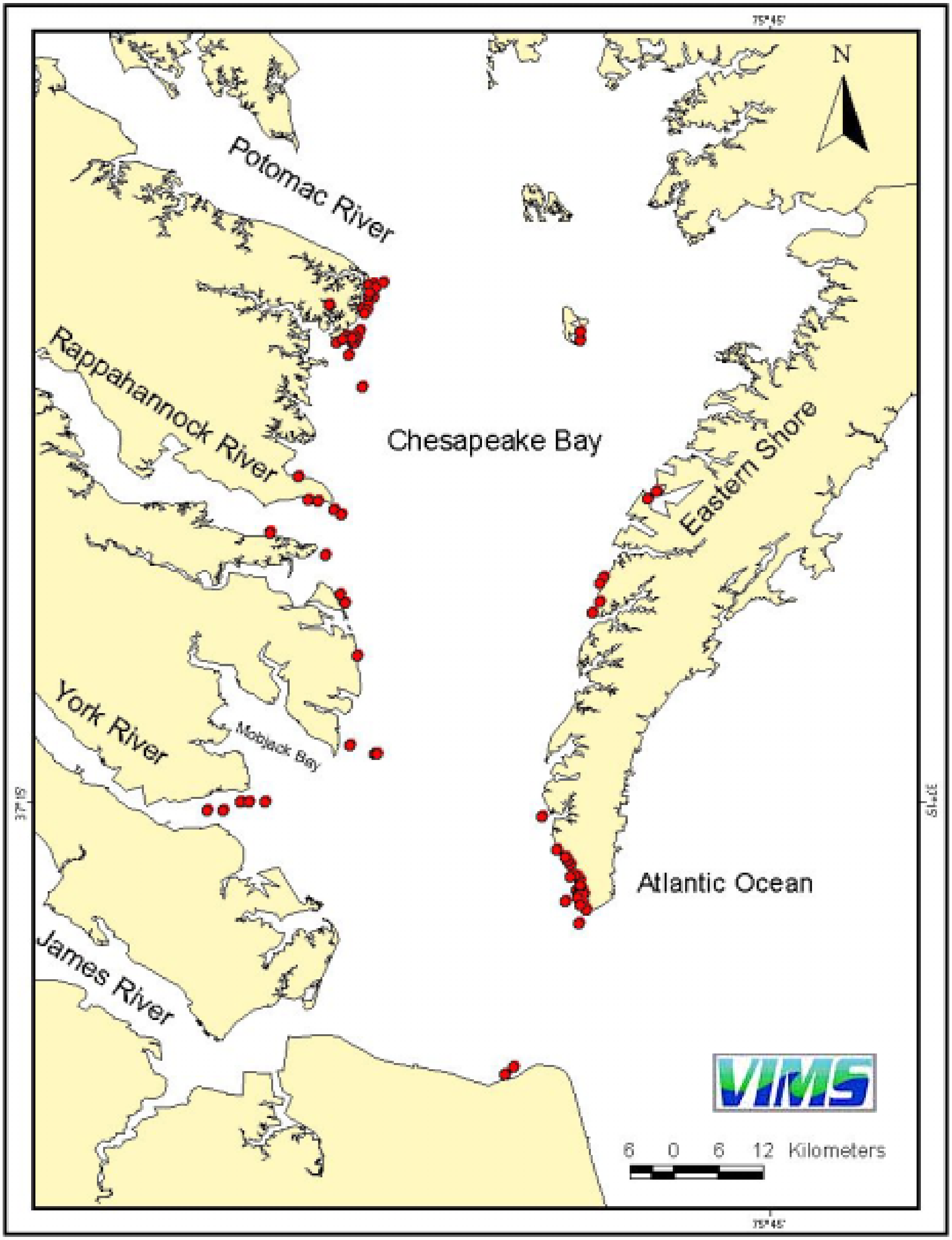


Figure 11. Poundnet stand locations in Virginia, June-October, 2001.

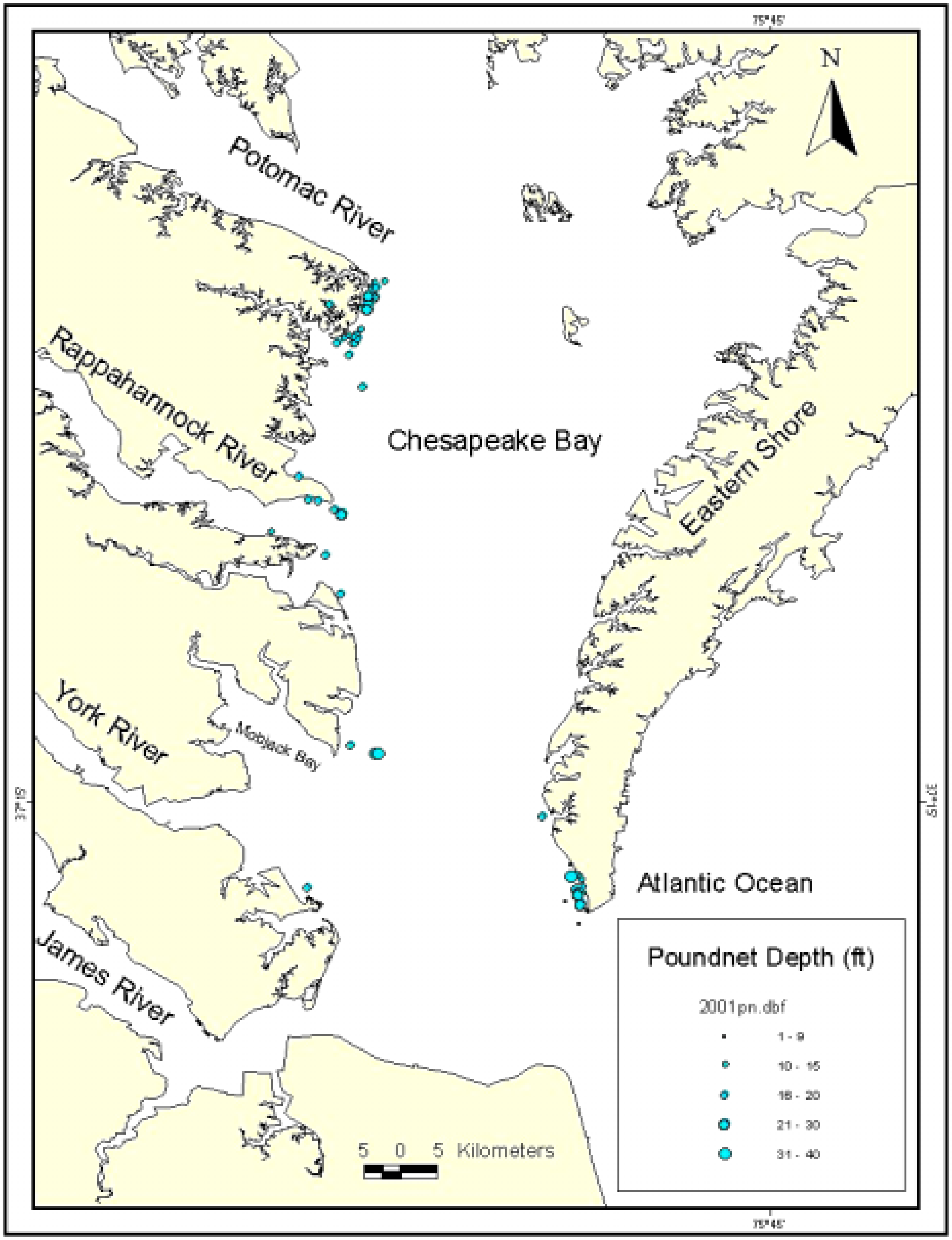


Figure 12. Locations of Virginia's poundnets by depth, June-October, 2001

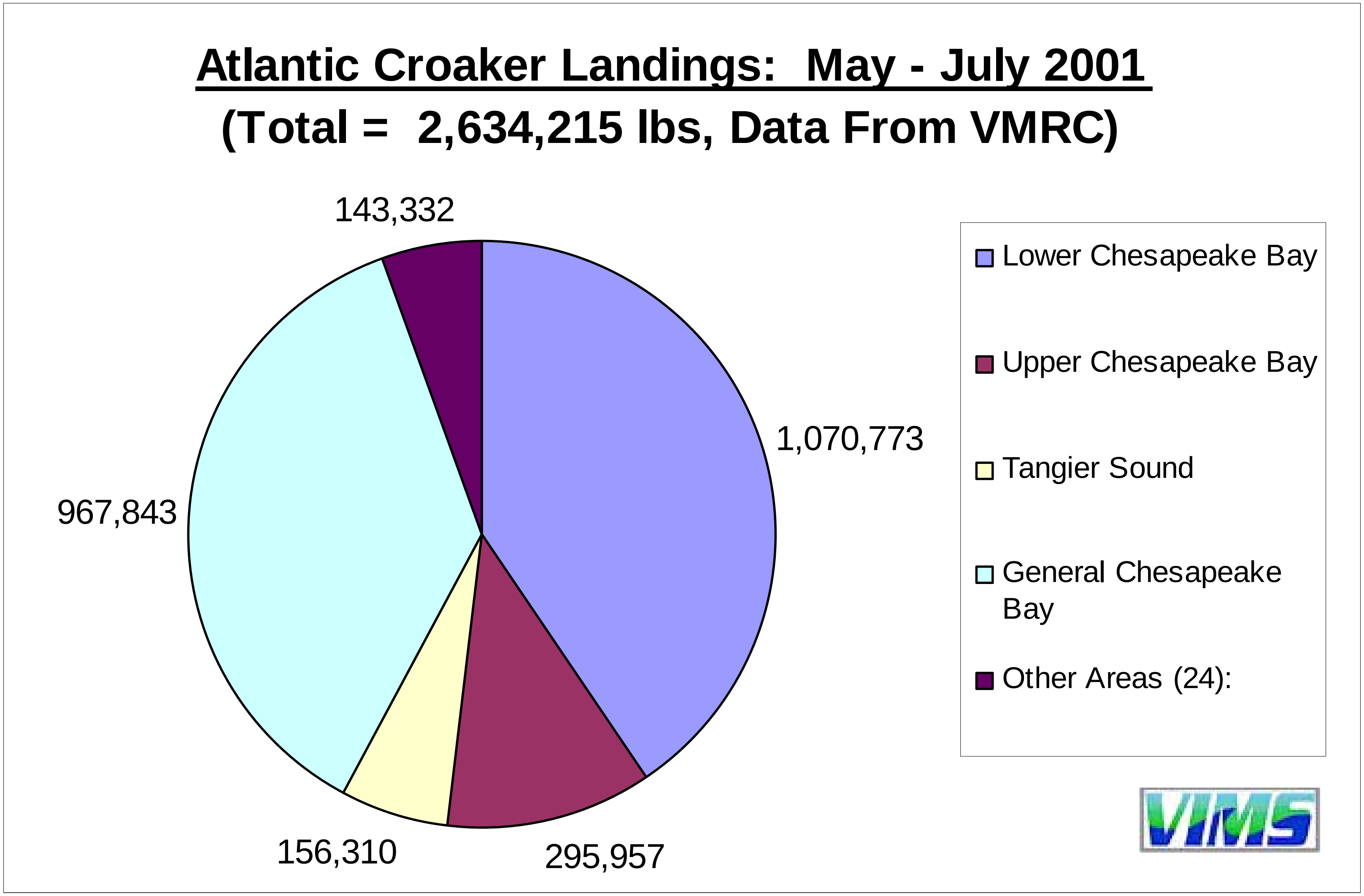


Figure 13. Distribution of Virginia gillnet landings of Atlantic croaker, May-July, 2001.

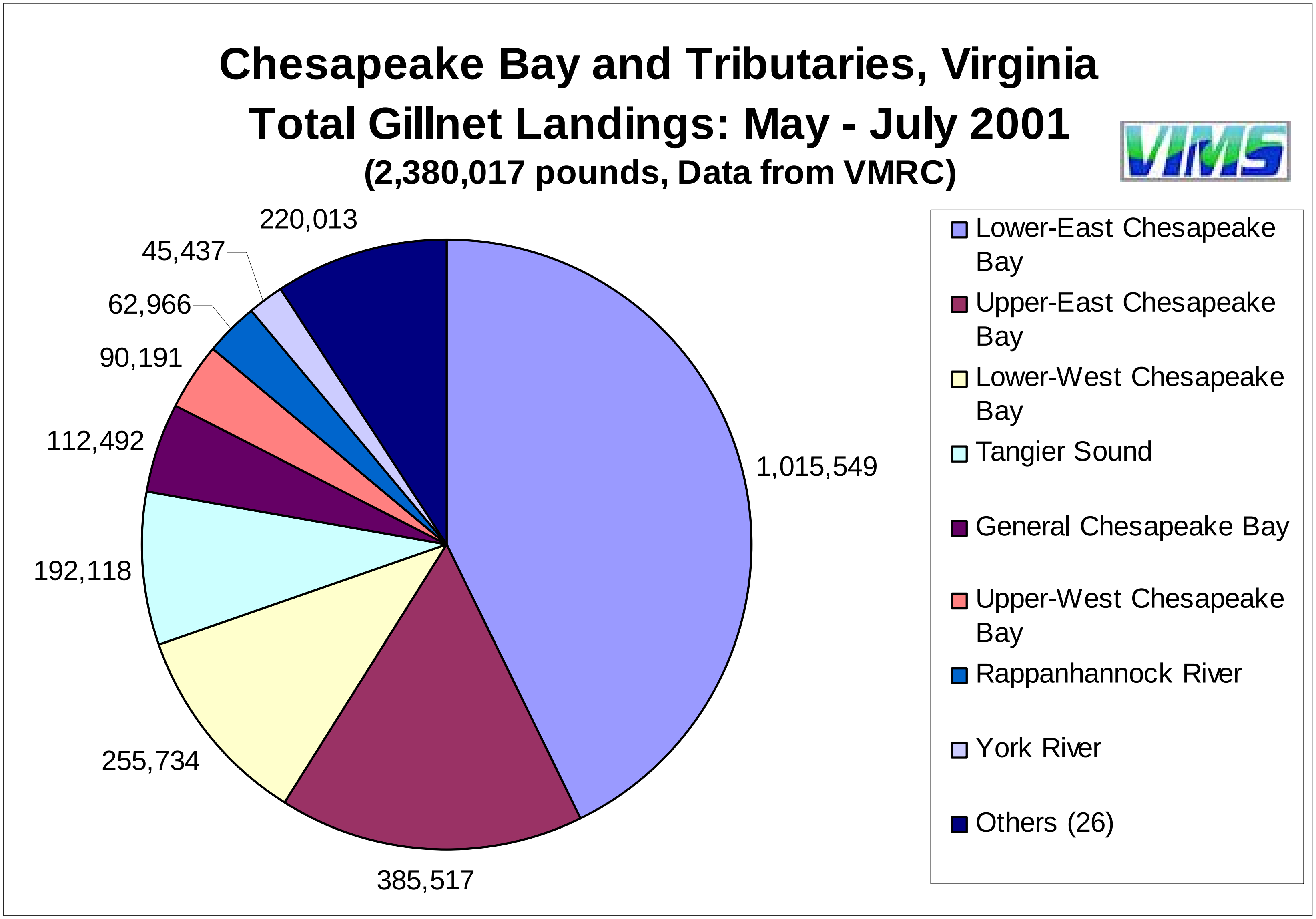


Figure 14. Distribution of all Virginia gillnet landings, May-July, 2001.

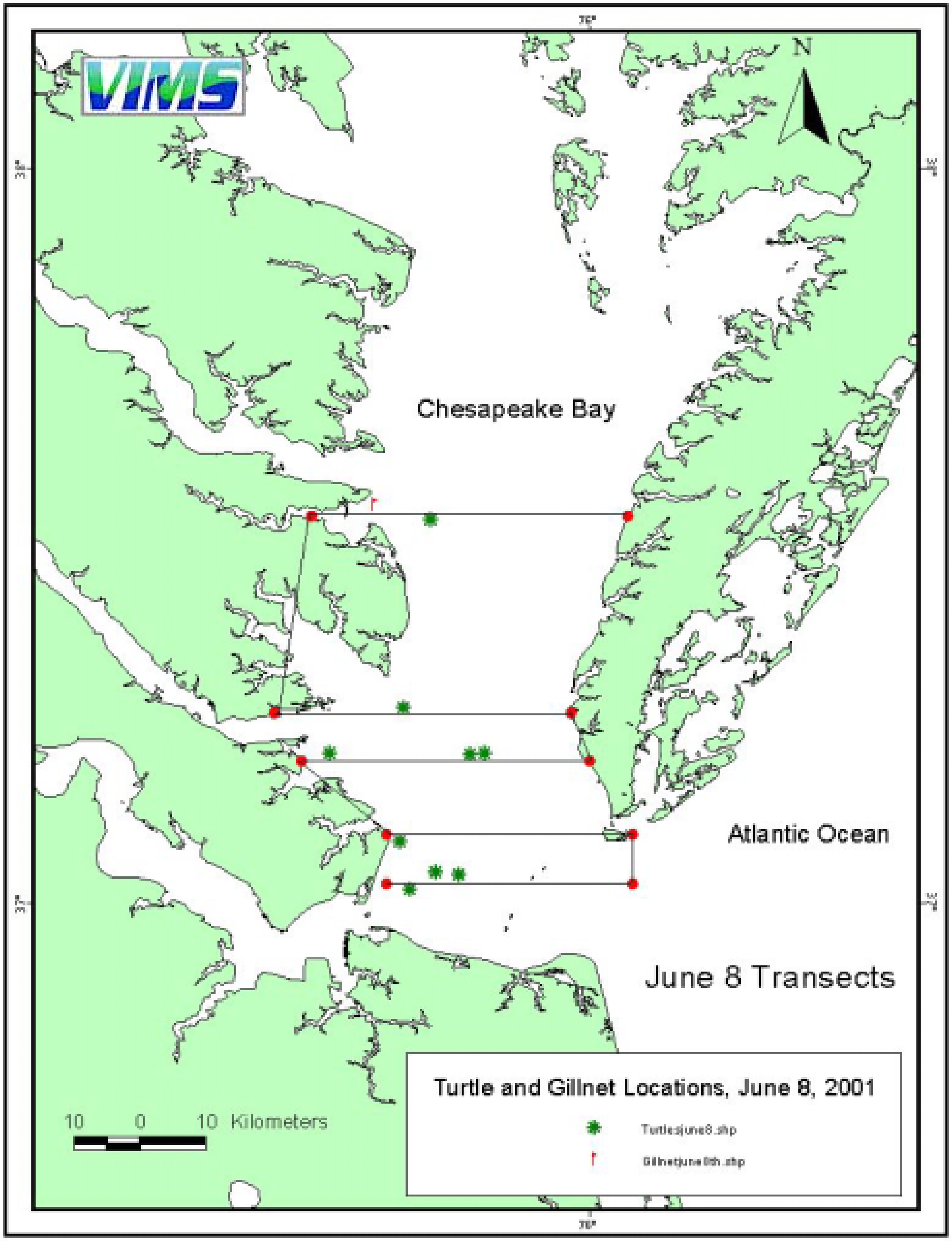


Figure 15. Locations of gillnets, turtles observed during the June 8, 2001 aerial survey.

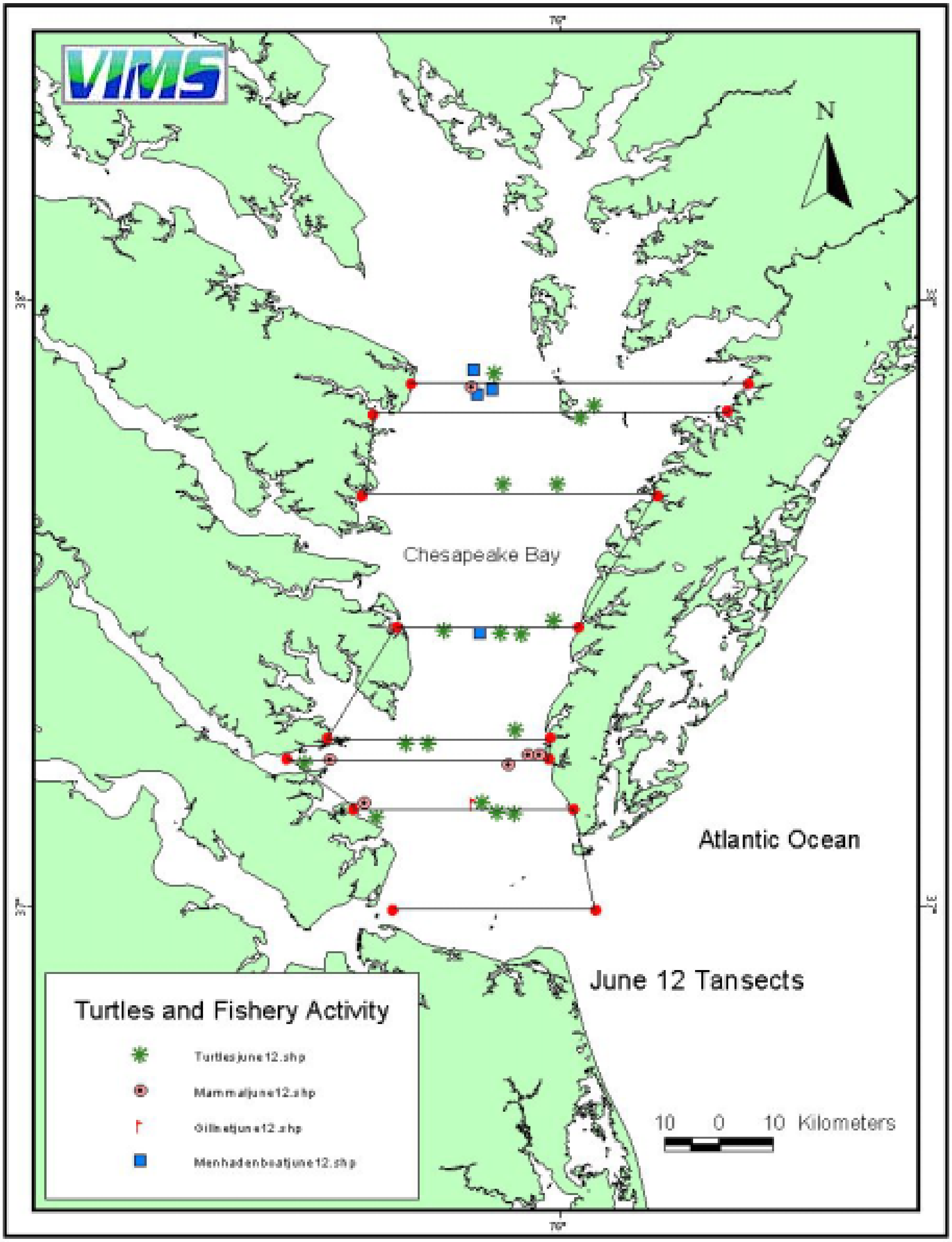


Figure 16. Locations of turtles, mammals and fisheries observed during the June 12, 2001 aerial survey.

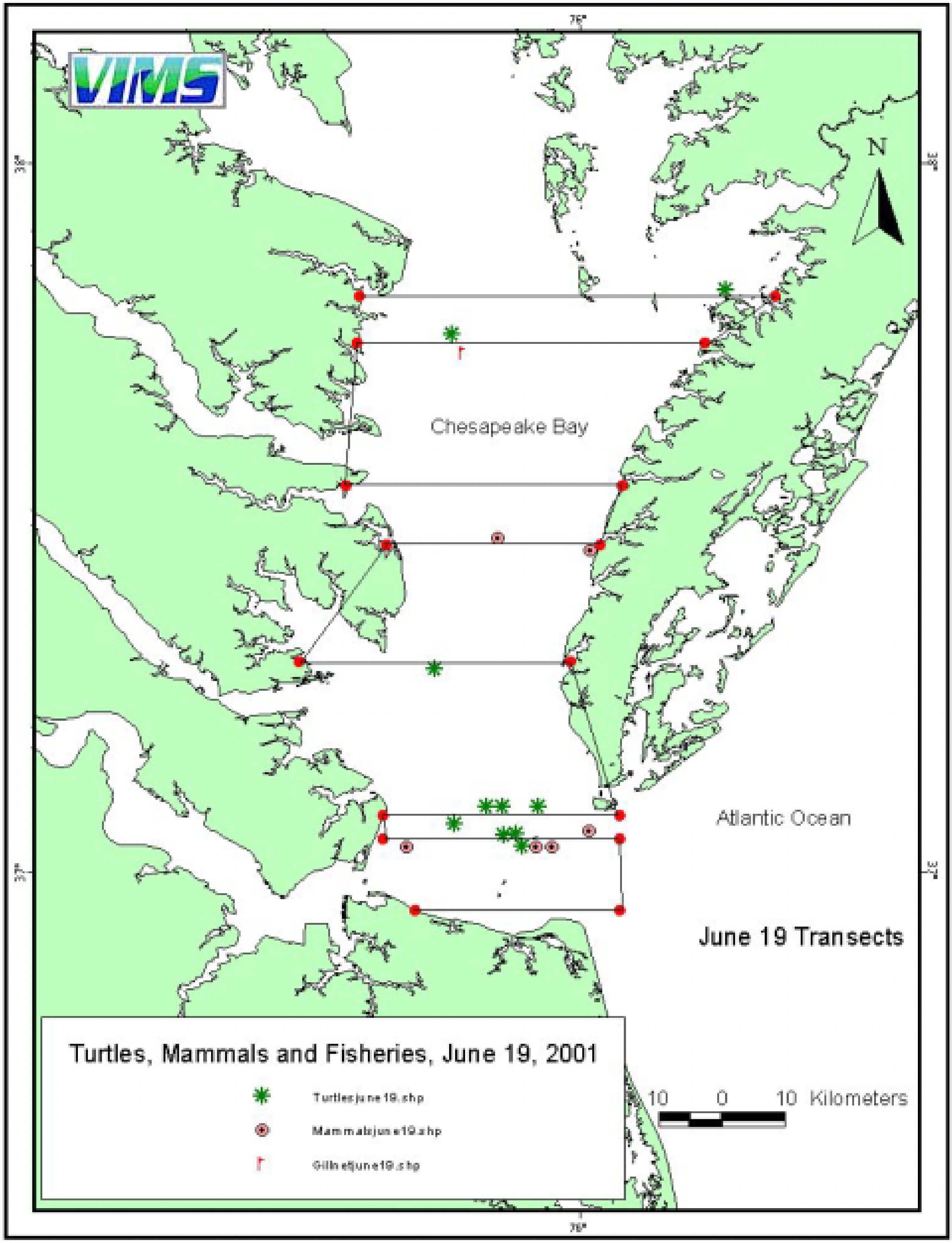


Figure 17. Locations of turtles, mammals and fisheries observed during the June 19, 2001 aerial survey.

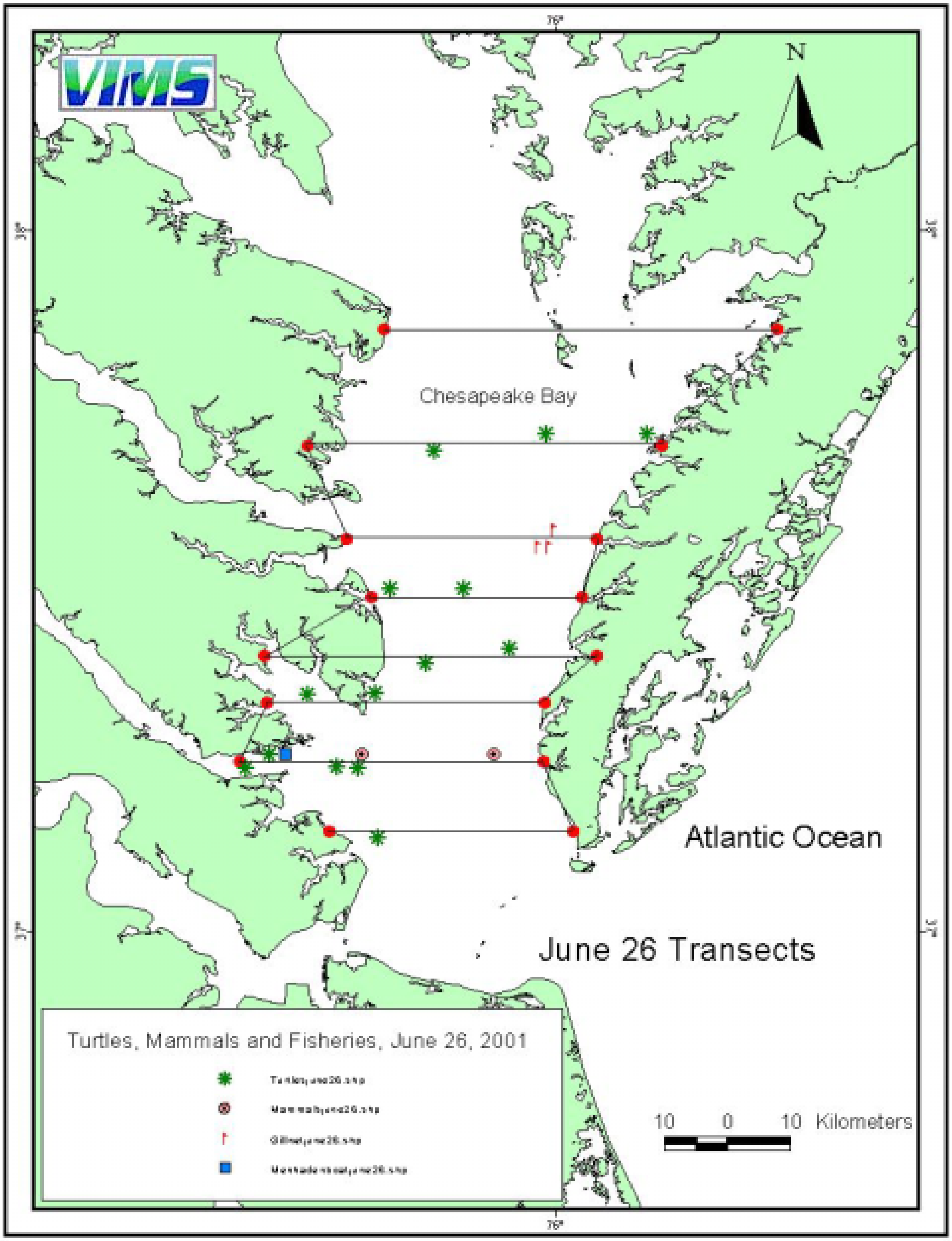


Figure 18. Locations of turtles, mammals and fisheries observed during the June 26, 2001 aerial survey.

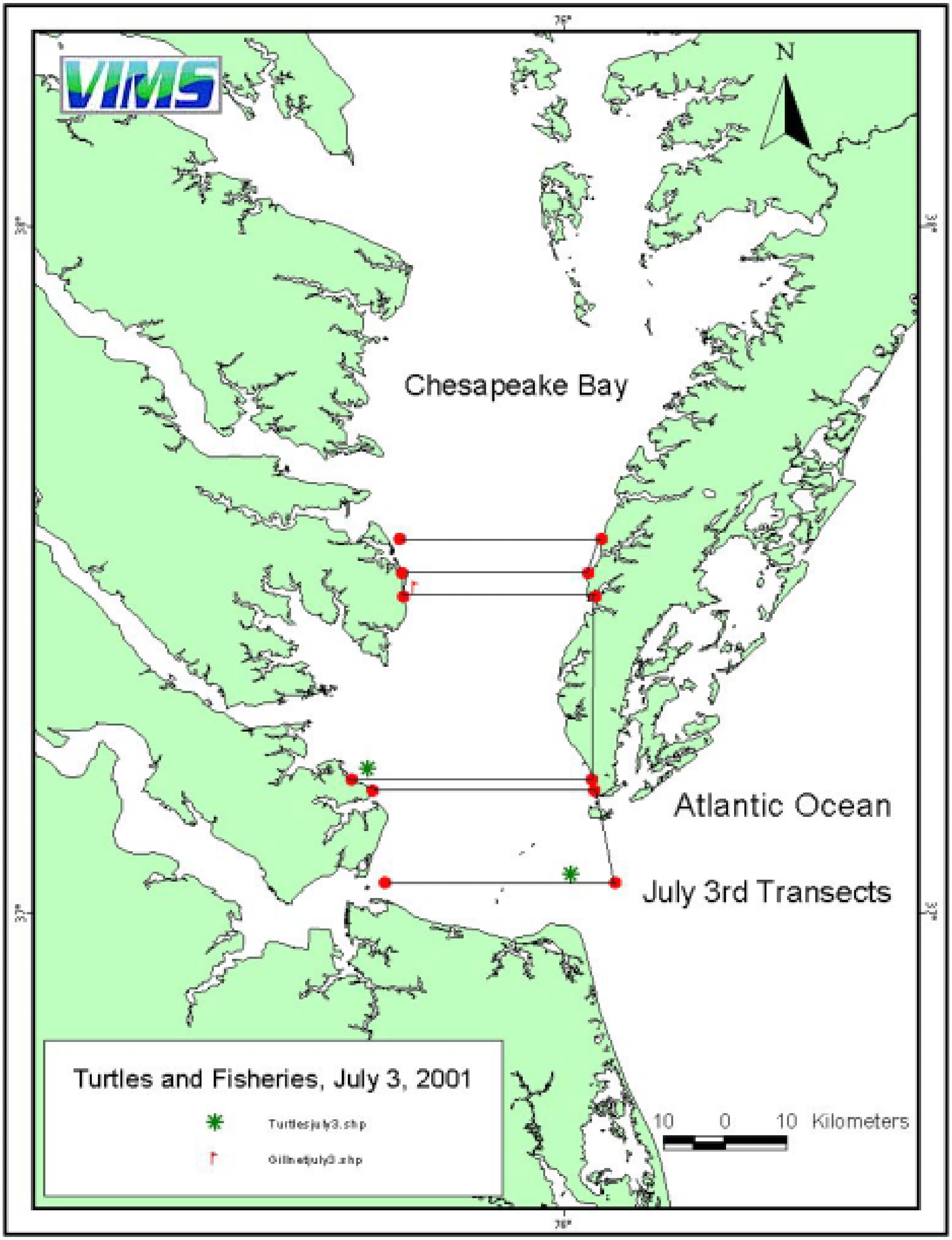


Figure 19. Locations of turtles and fisheries observed during the July 3, 2001 aerial survey. NOTE: only six transects flown this survey due to inclement weather.

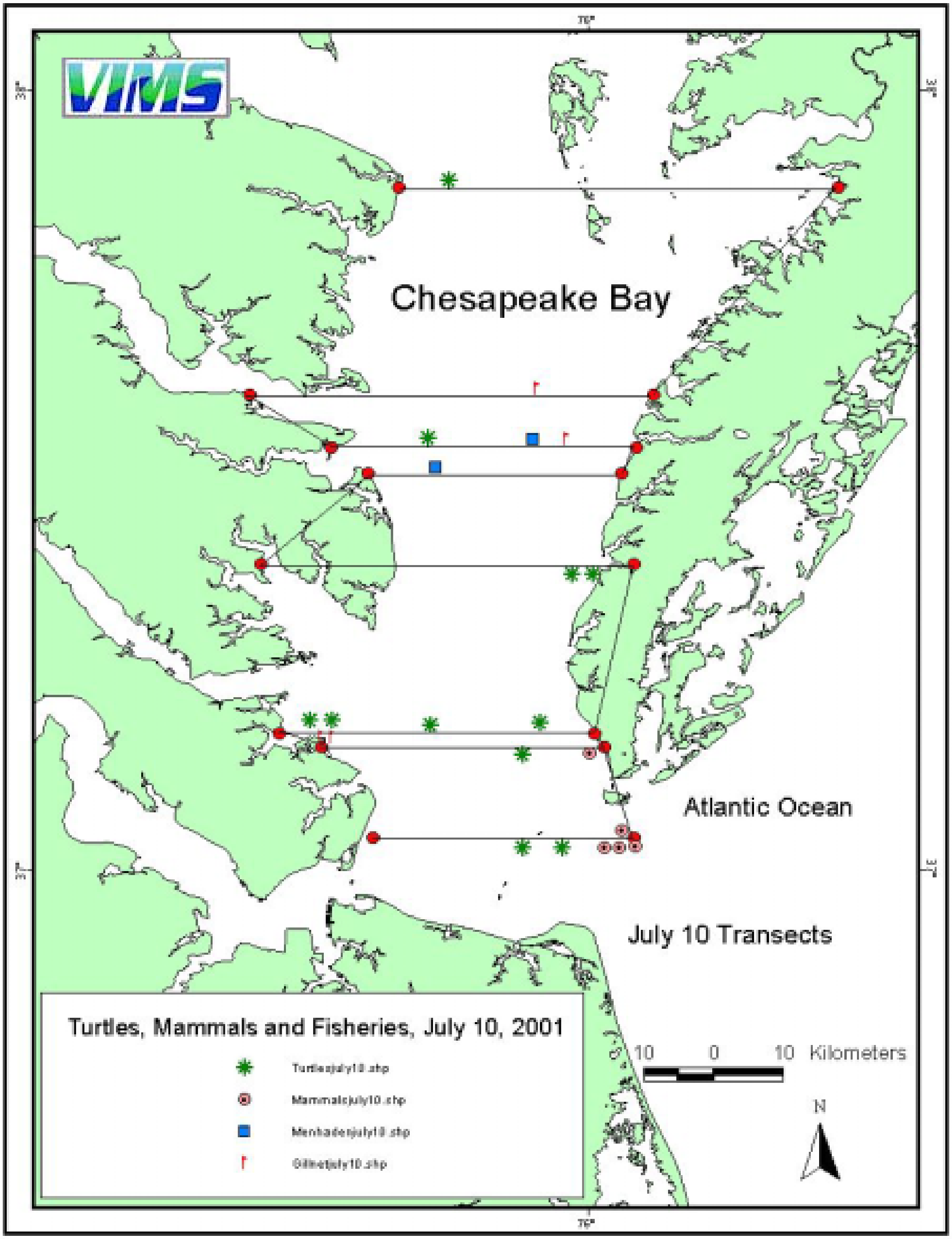


Figure 20. Locations of turtles, mammals and fisheries observed during the July 10, 2001 aerial survey.

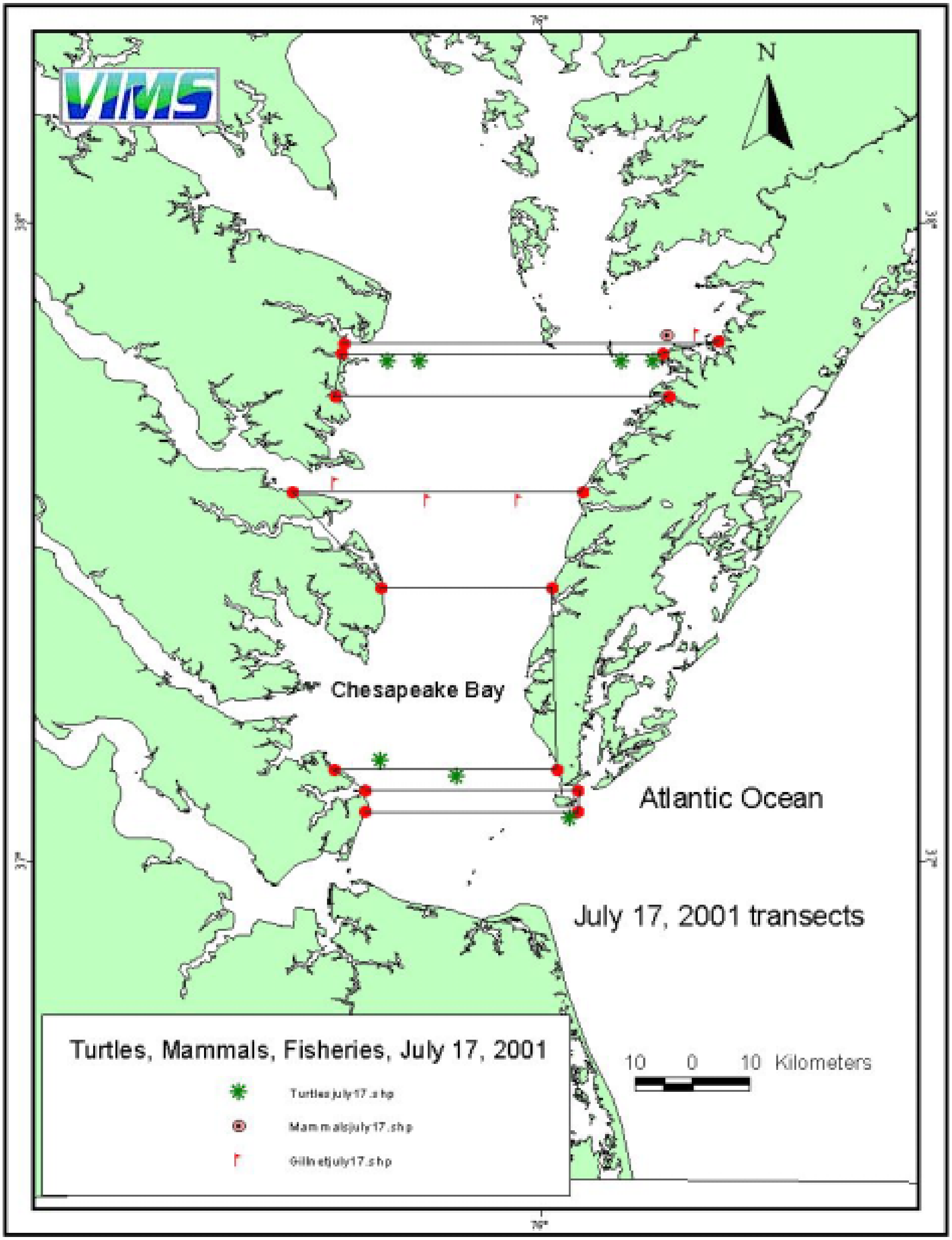


Figure 21. Locations of turtles, mammals and fisheries observed during the July 17, 2001 aerial survey.

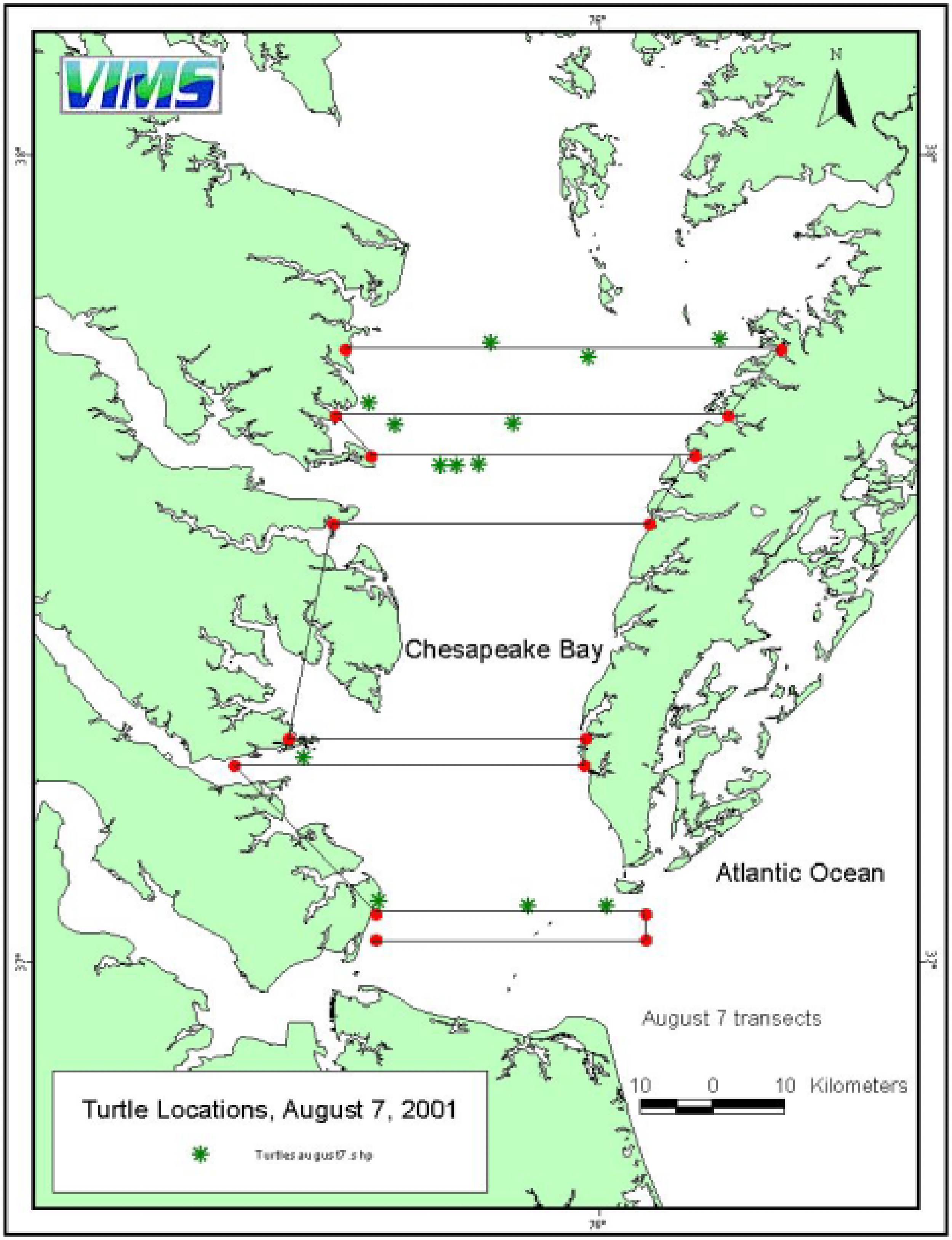


Figure 22. Locations of turtles observed during the August 7, 2001 aerial survey.

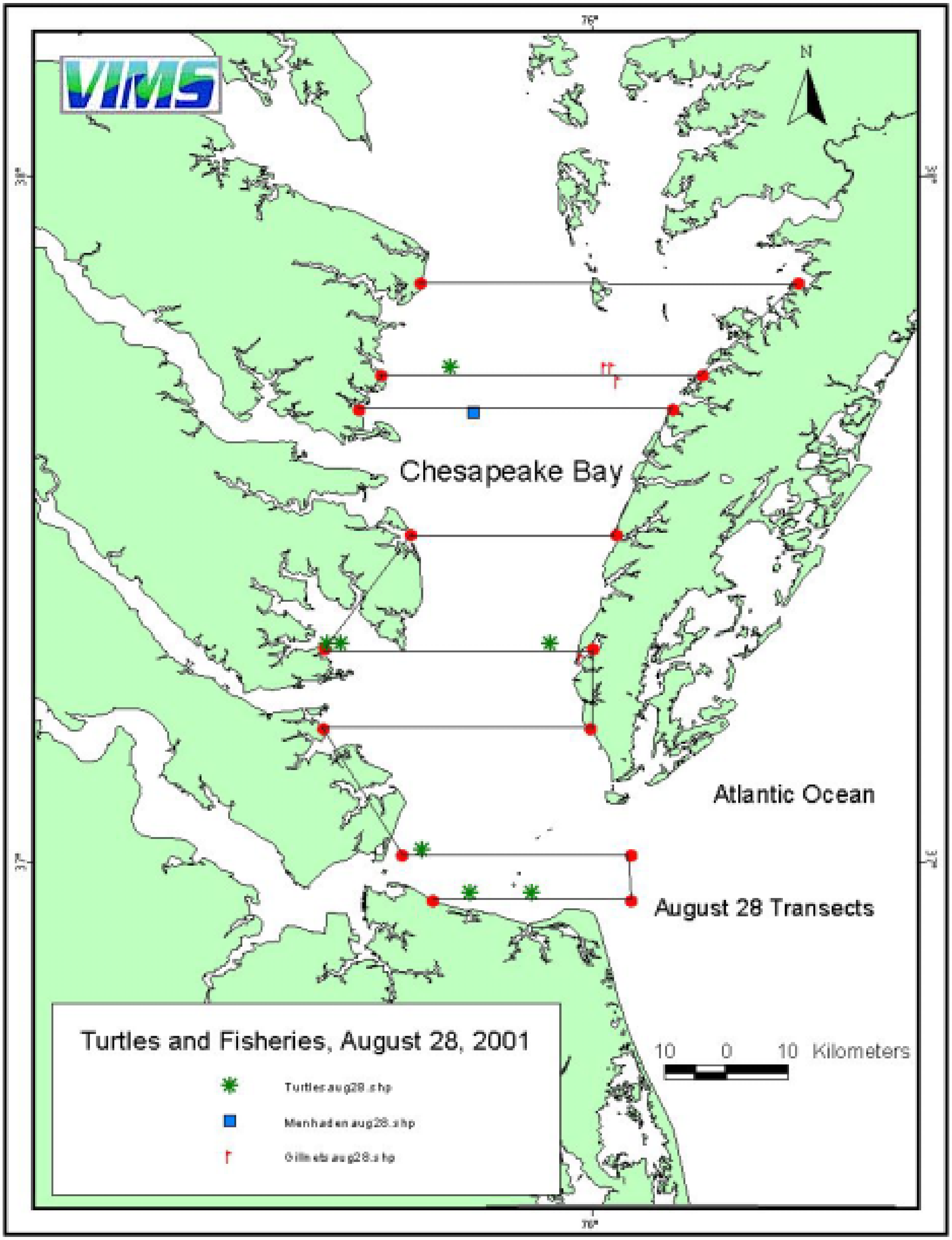


Figure 23. Locations of turtles and fisheries observed during the August 28, 2001 aerial survey.

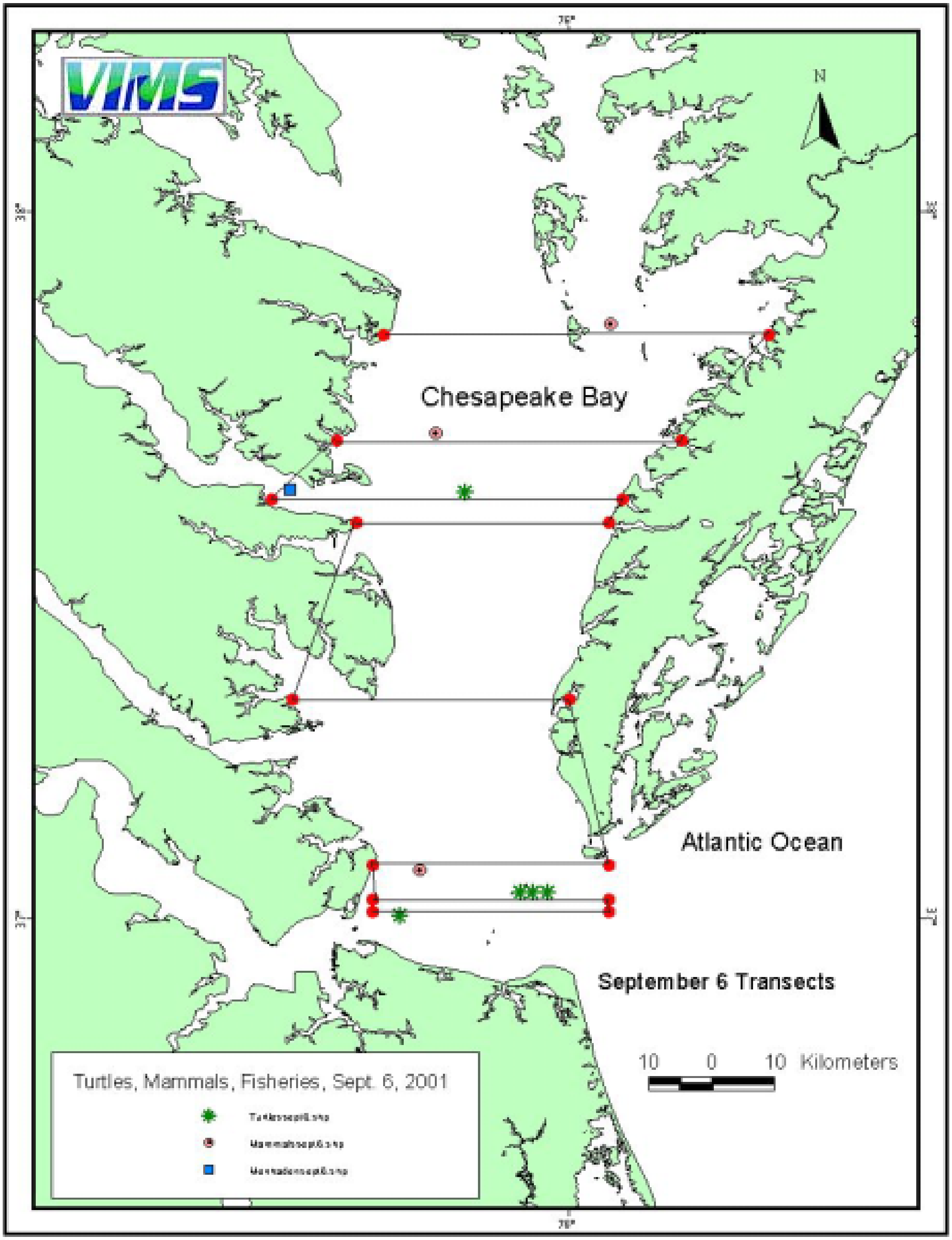


Figure 24. Locations of turtles, mammals and fisheries observed during the September 6, 2001 aerial survey.

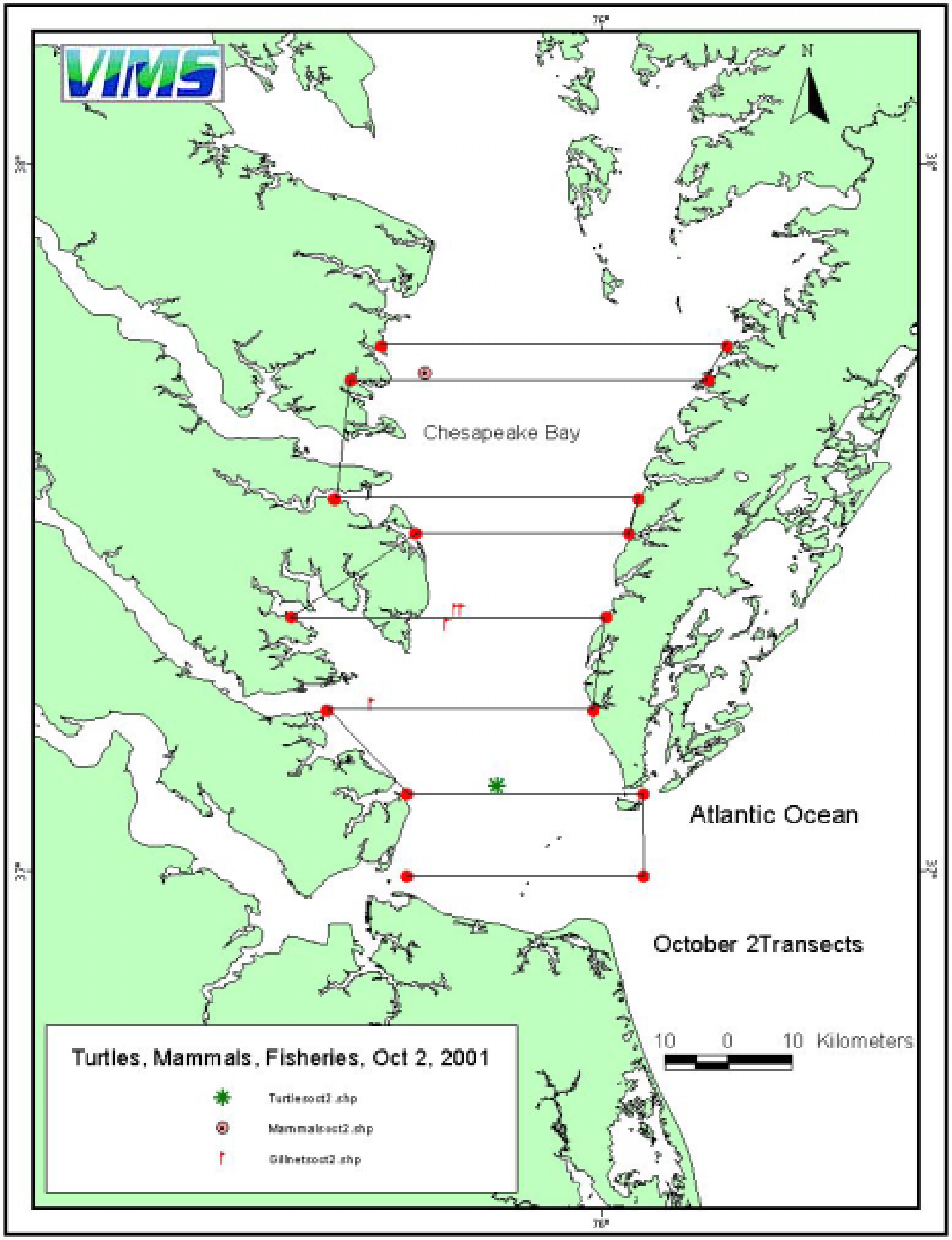


Figure 25. Locations of turtles, mammals and fisheries observed during the October 2, 2001 aerial survey.

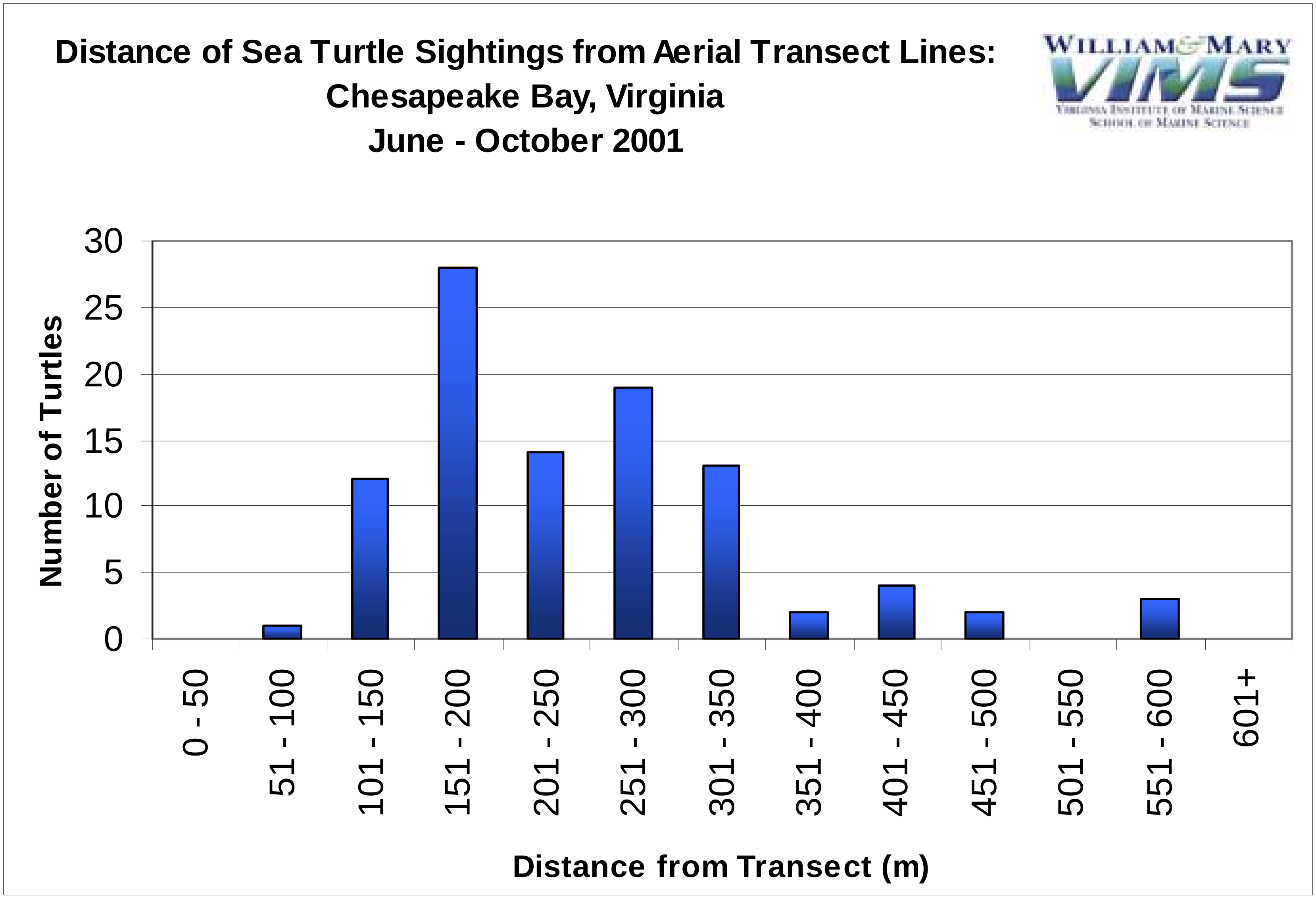


Figure 26. Distances of sea turtle sightings from aerial transect lines, June-October, 2001. All turtles observed outside the 50m to 300 m survey strip were removed from the analyses.

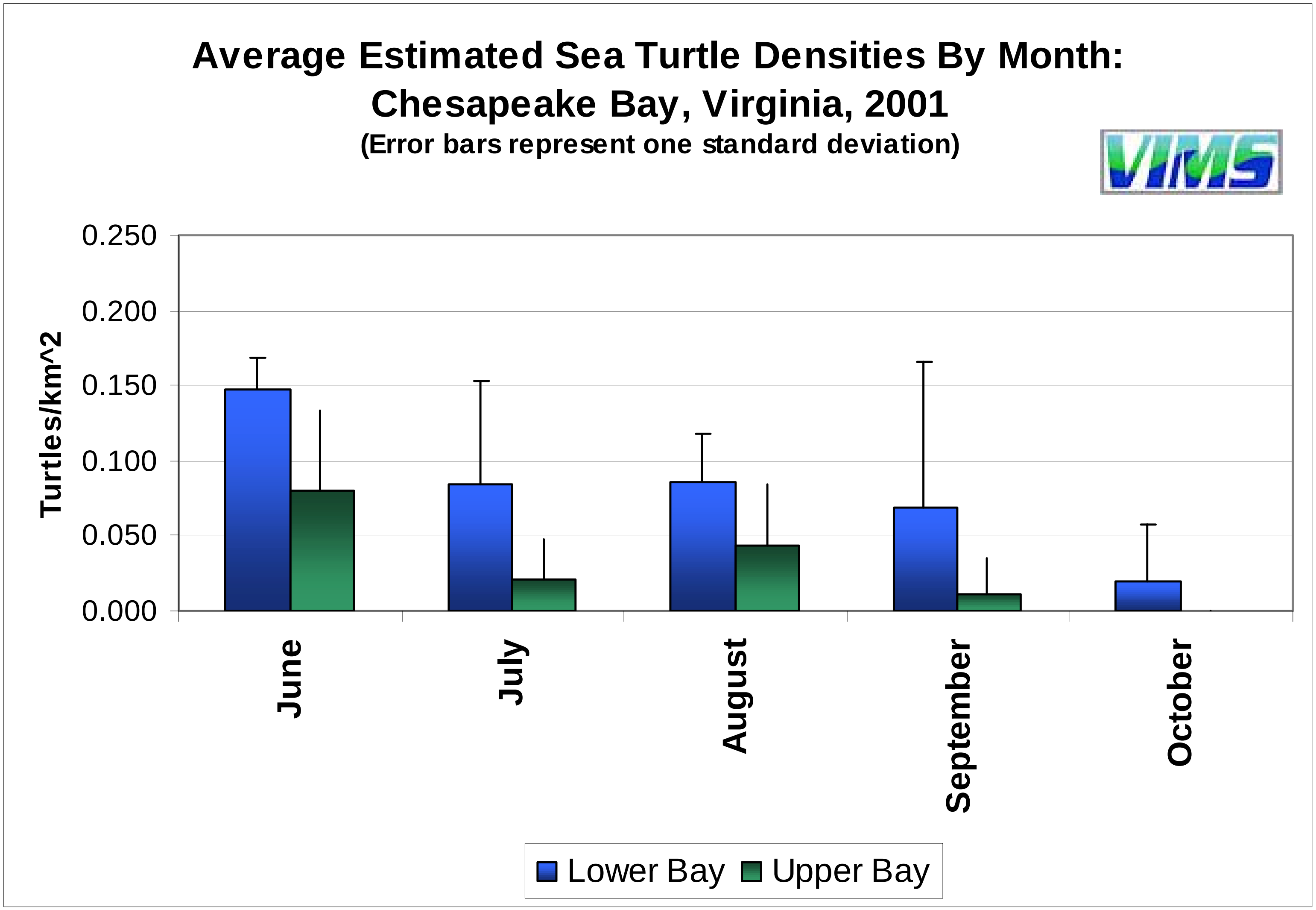


Figure 27. Average (uncorrected) Virginia sea turtle densities by month and region, June-October, 2001. Note: September and October are represented by only one survey.

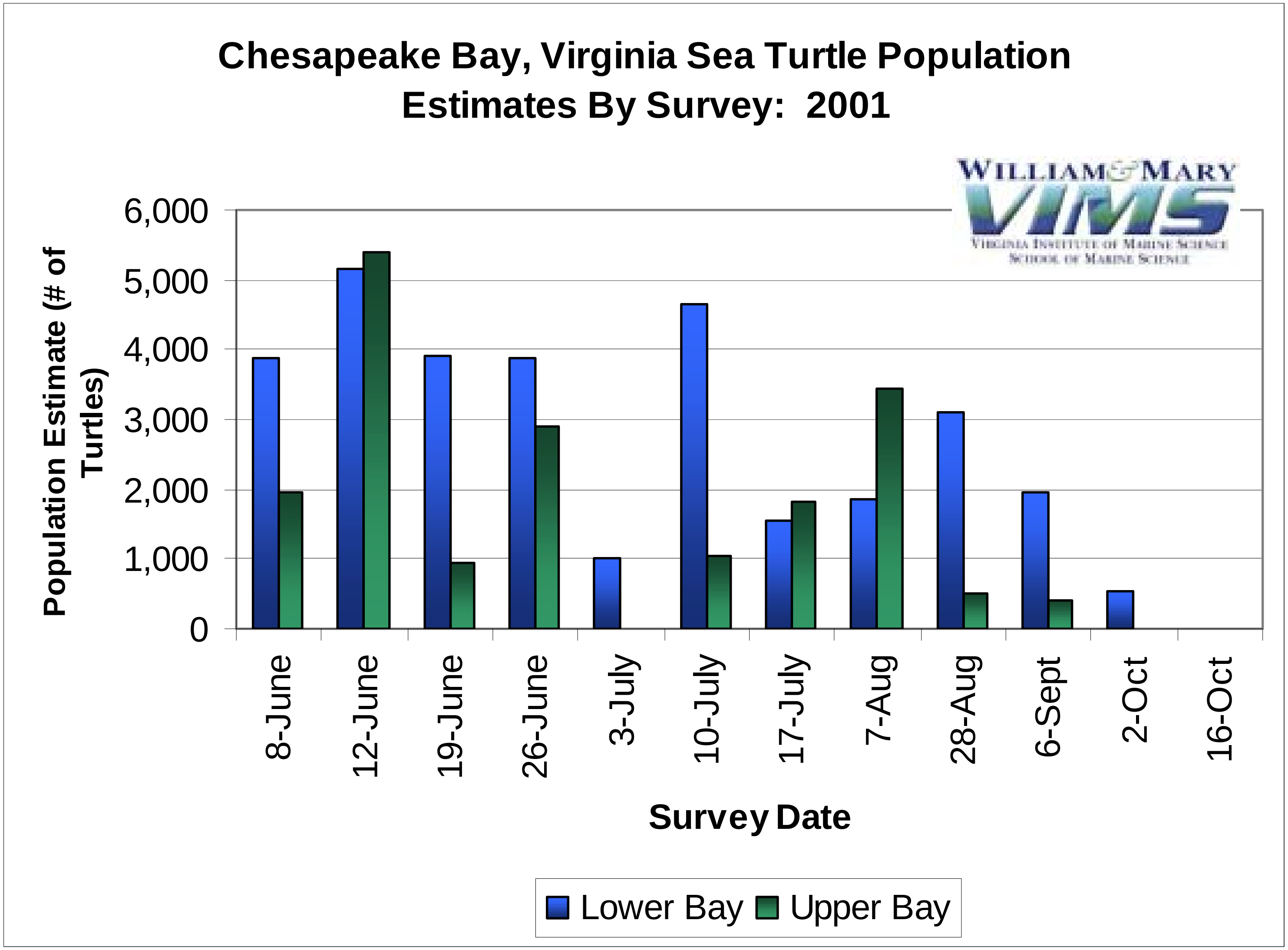


Figure 28. 2001 sea turtle population estimates per survey for the Chesapeake Bay, Virginia, June-October 2001.

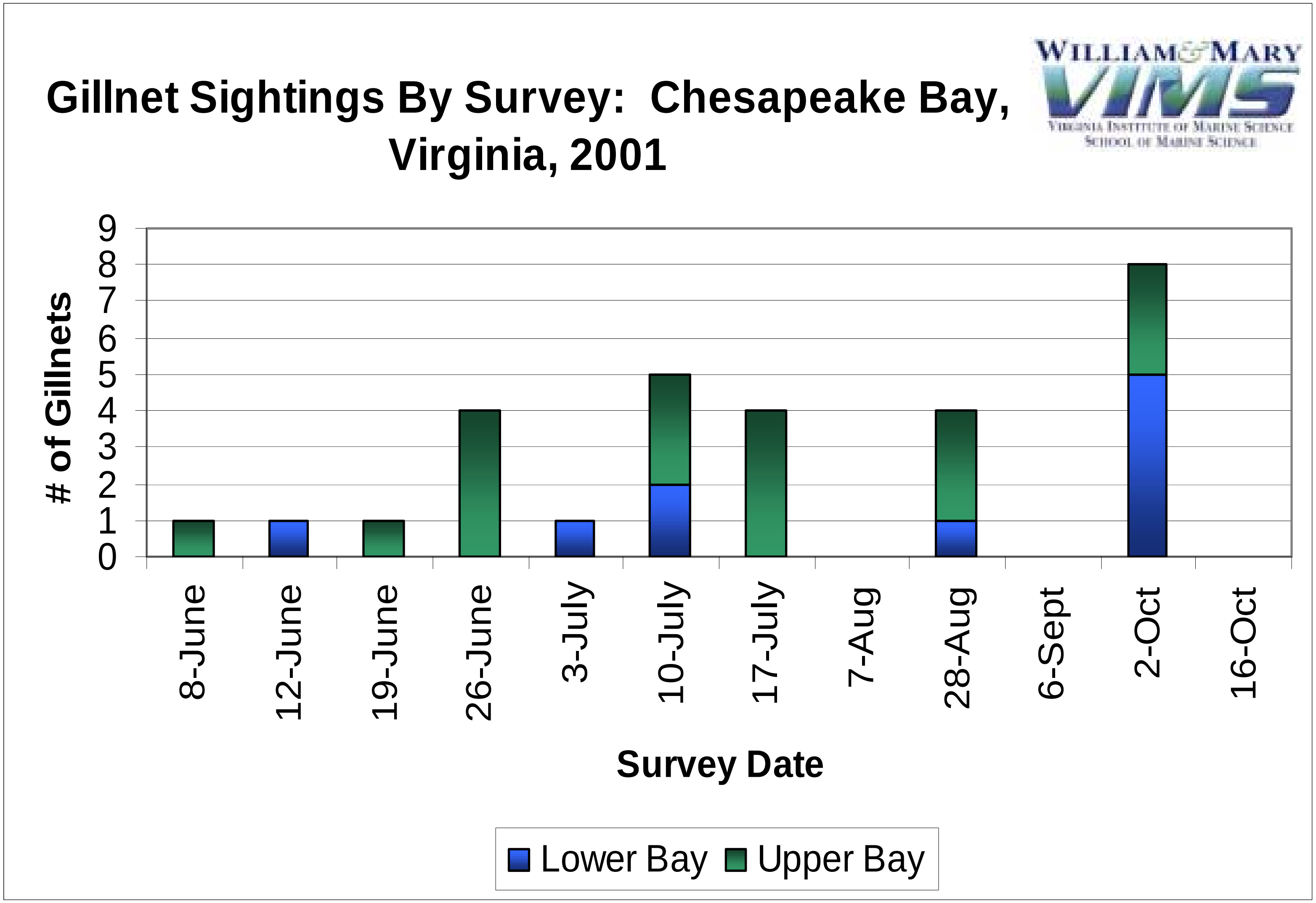


Figure 29. Aerial sightings of gillnets in the Chesapeake Bay, Virginia, June-October, 2001. NOTE: Each record represents a flag observed in the water. Gillnets are set with two flags: one at each end of the net. The October observations most likely represent four nets, based on our observations.

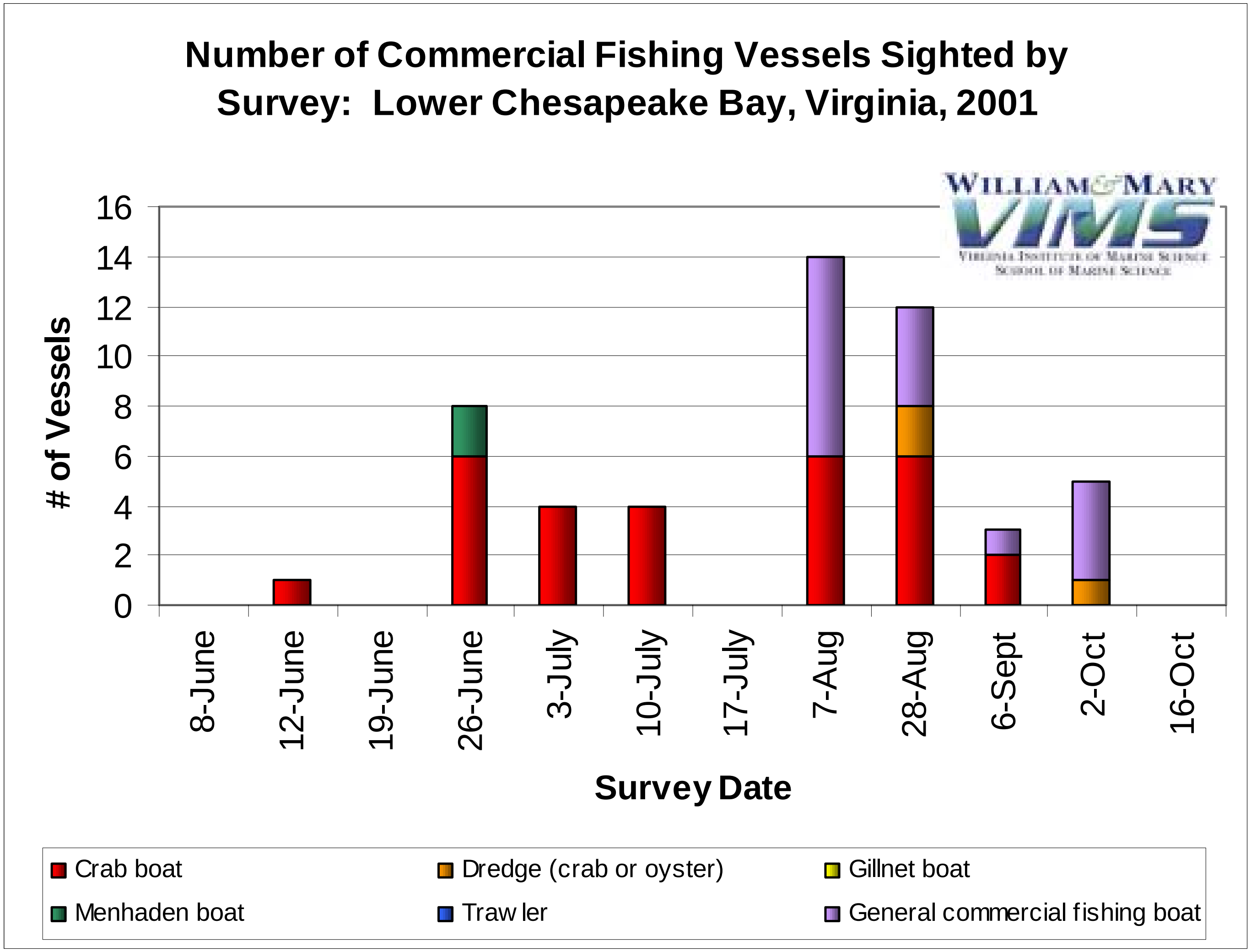


Figure 30. Aerial sightings of commercial fishing vessels in the Lower Chesapeake Bay, Virginia, June-October, 2001.

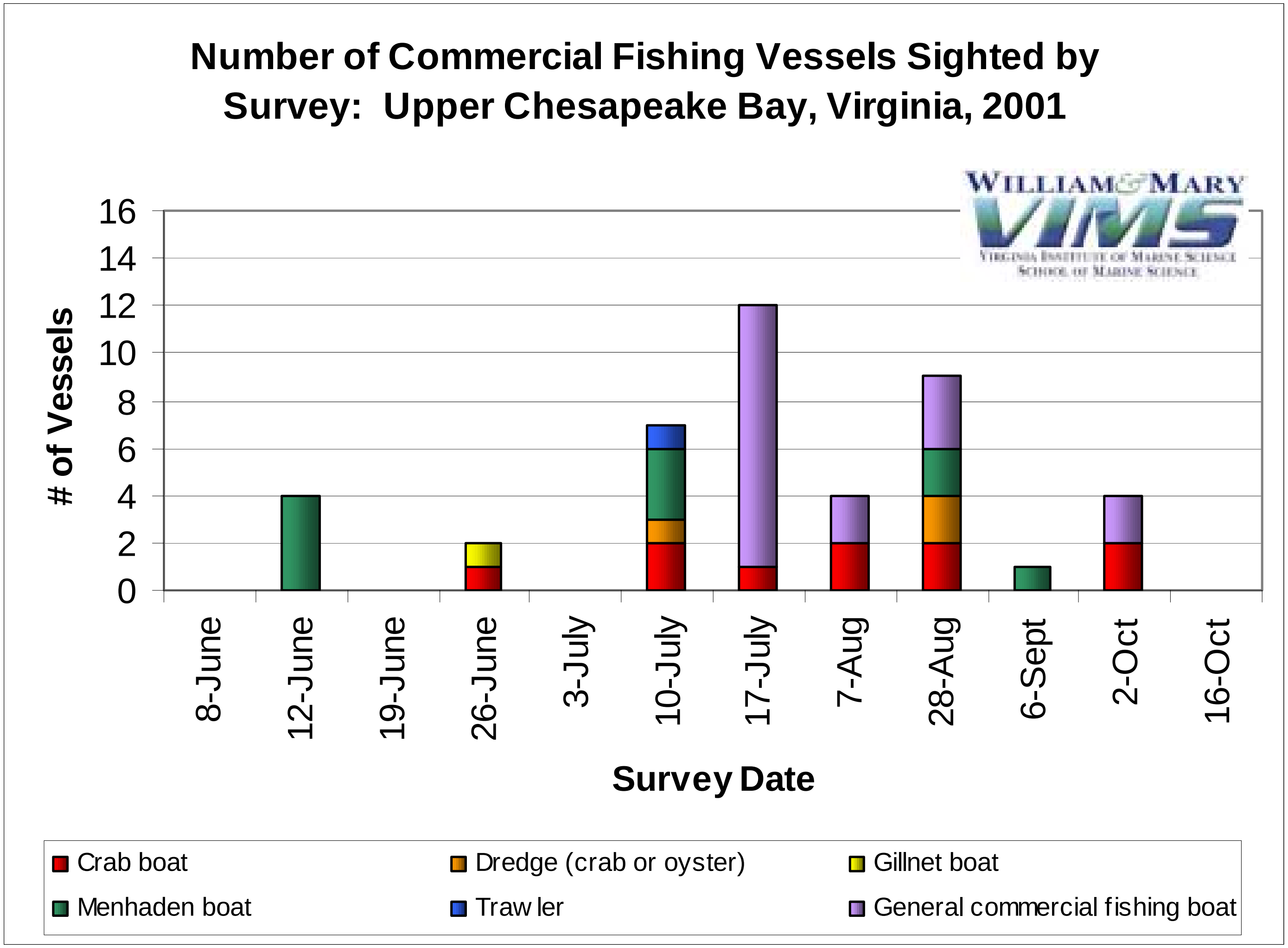


Figure 31. Aerial sightings of commercial fishing vessels in the Upper Chesapeake Bay, Virginia, June-October, 2001.

FIGURE 32. Blue crab MPAC, from Lipcius et al., in press (with permission).

PLATES

Plate 1. 900 kHz side scan sonar tow fish (Marine Technology) used in side scan sonar survey.

Plate 2. Ground truthing of juvenile loggerhead sea turtle (49.0 cm CCL) by side scan sonar.

Plate 3. Ground truthing of juvenile Kemp's ridley sea turtle (35.0 cm CCL) by side scan sonar)

Plate 4. Ground truthing of plastic bag by side scan sonar

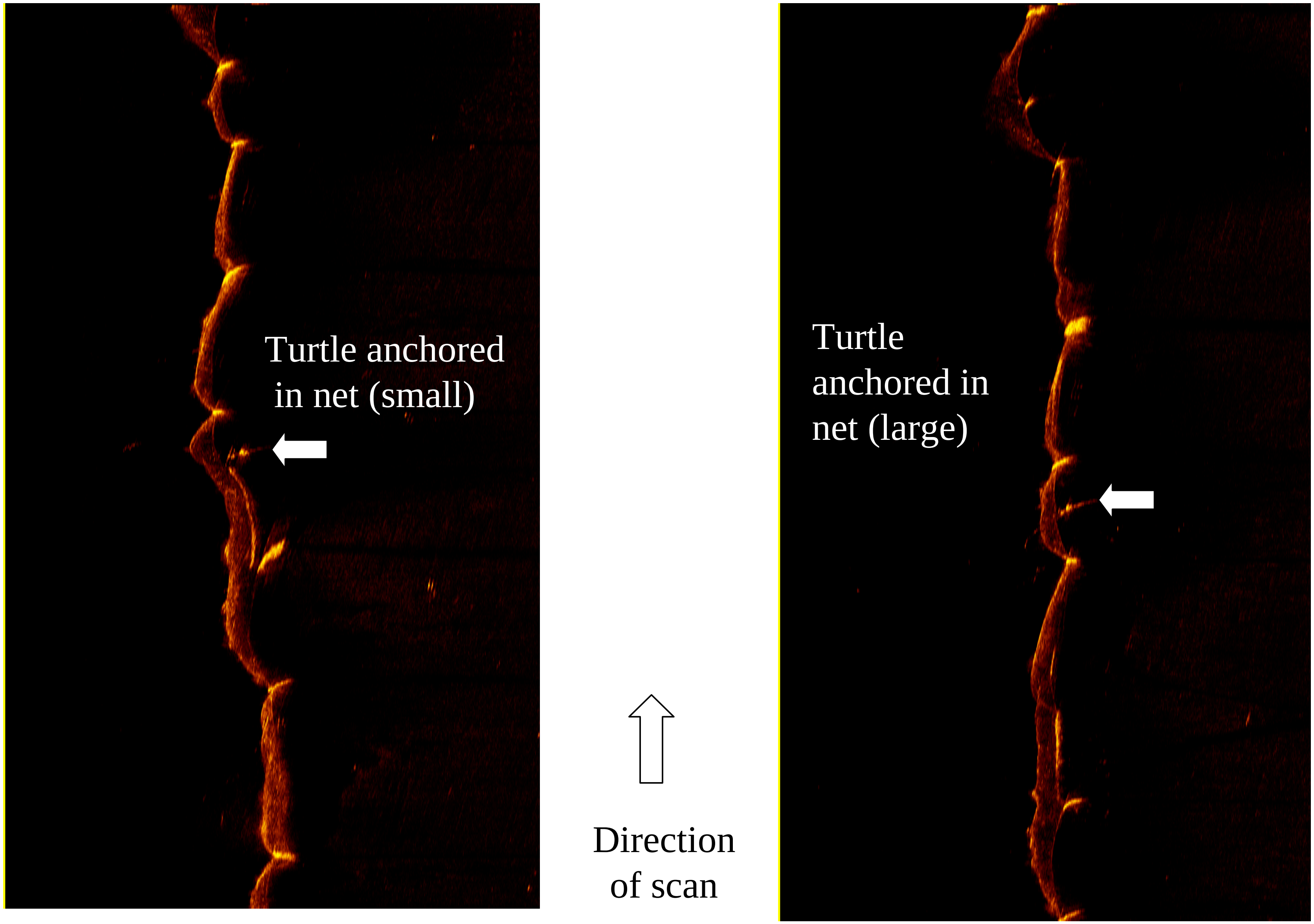


Plate 5. Ground-truthing sonar with turtle carcasses in VIMS poundnet (May, 2001)

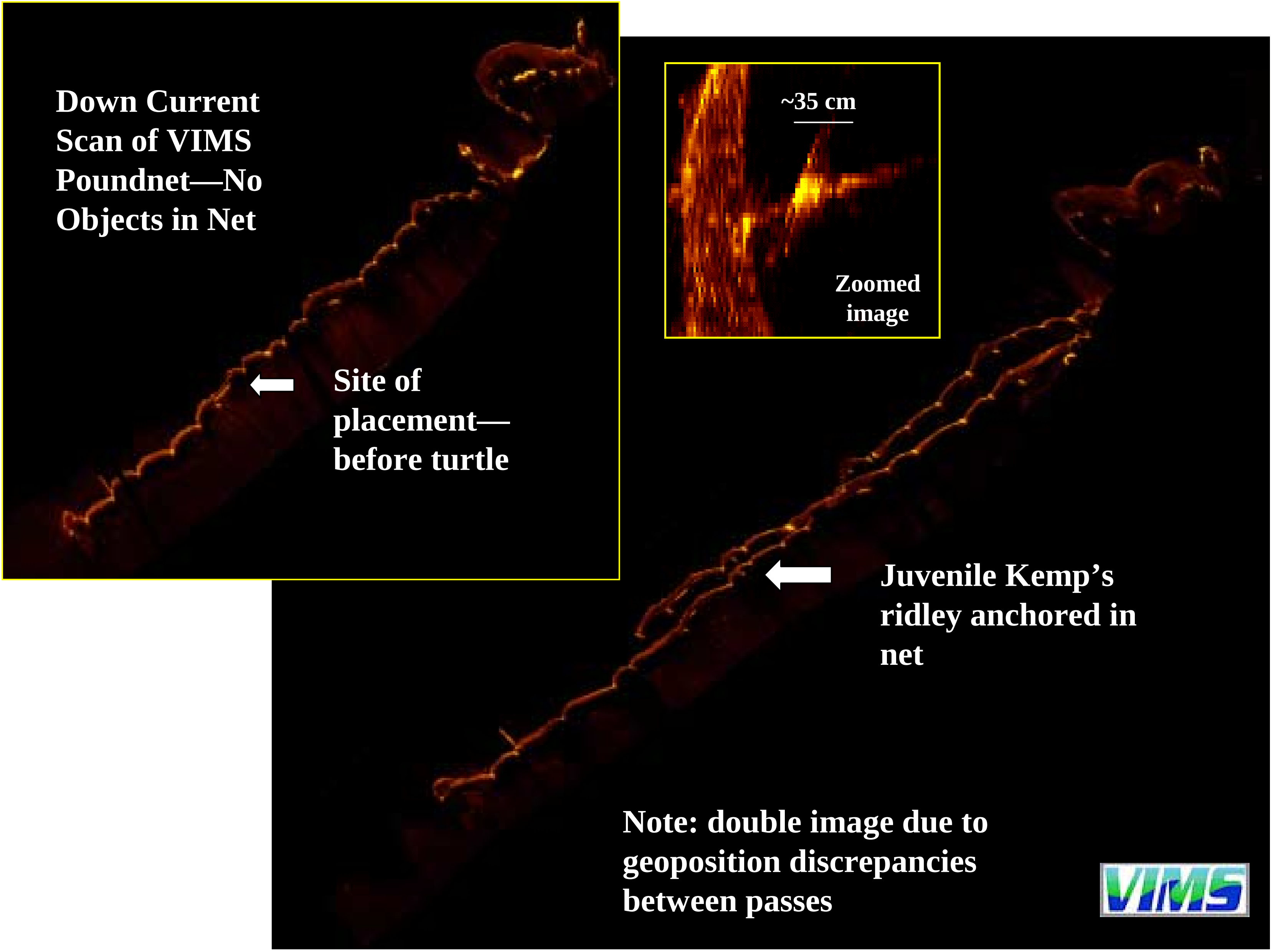


Plate 6. Ground truthing of juvenile Kemp’s ridley by side scan sonar (mosaic by Art Trembanis).

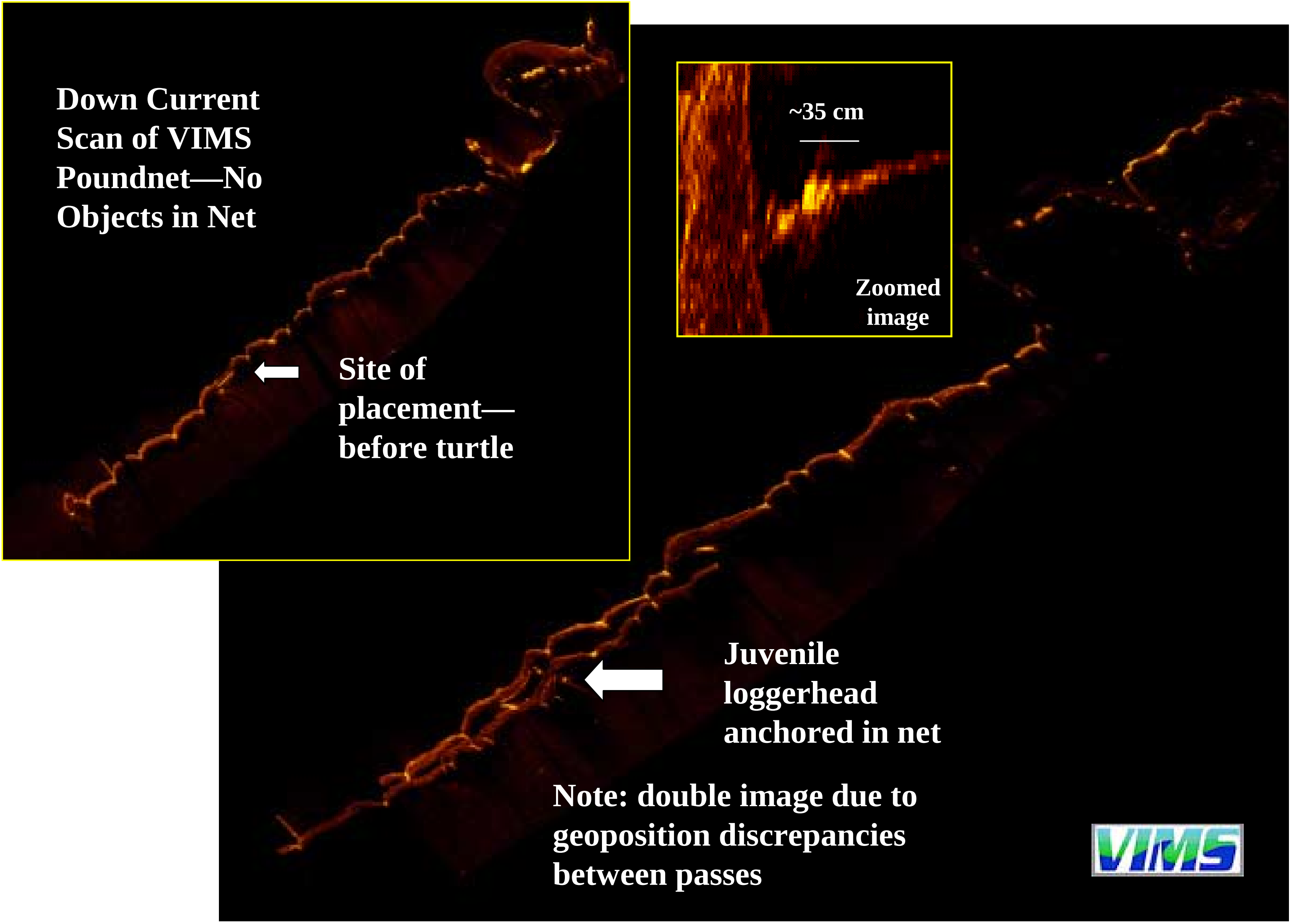


Plate 7. Ground truthing of juvenile loggerhead by side scan sonar (mosaic by Art Trembanis).

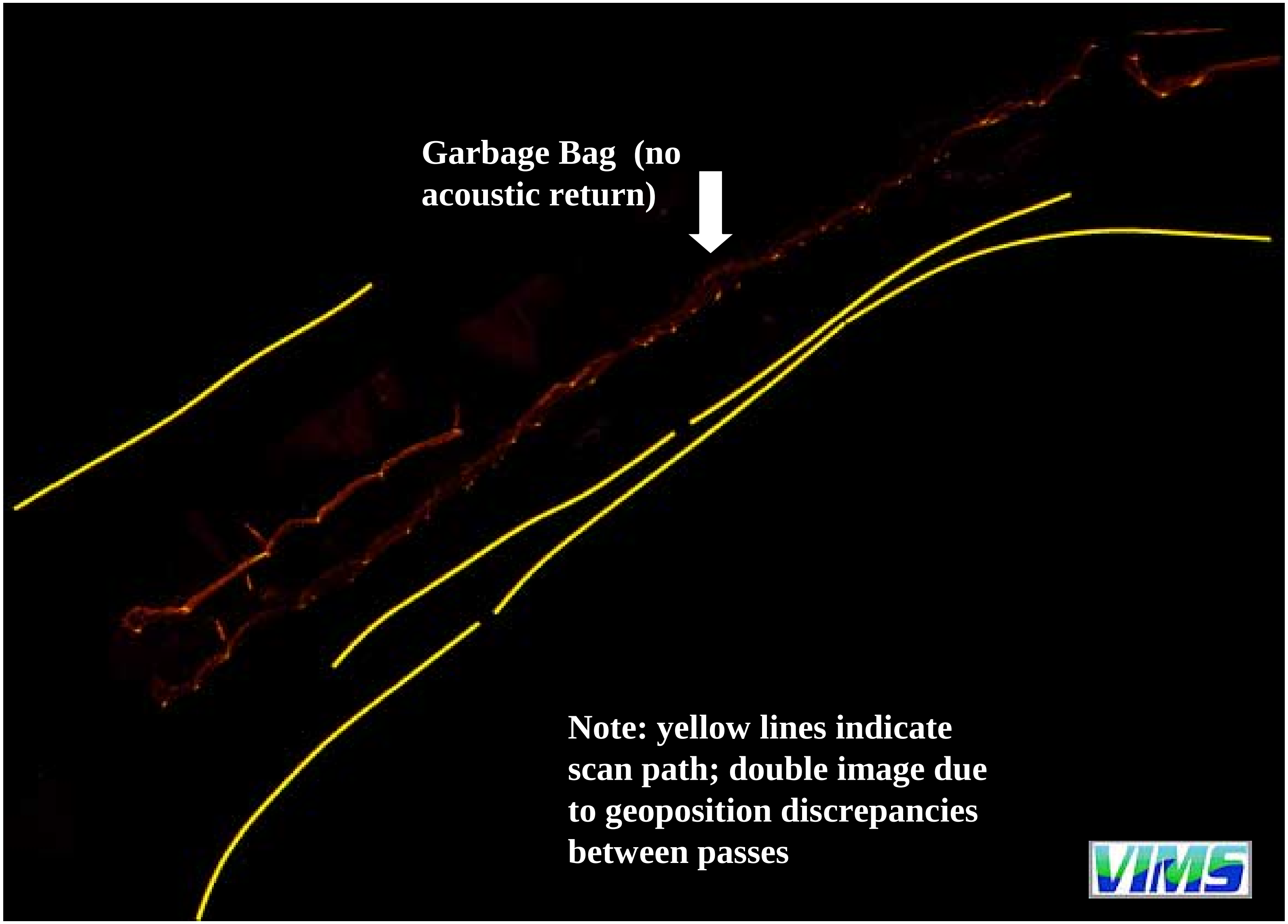


Plate 8. Ground truthing of garbage bag by side scan sonar (mosaic by Art Trembanis).

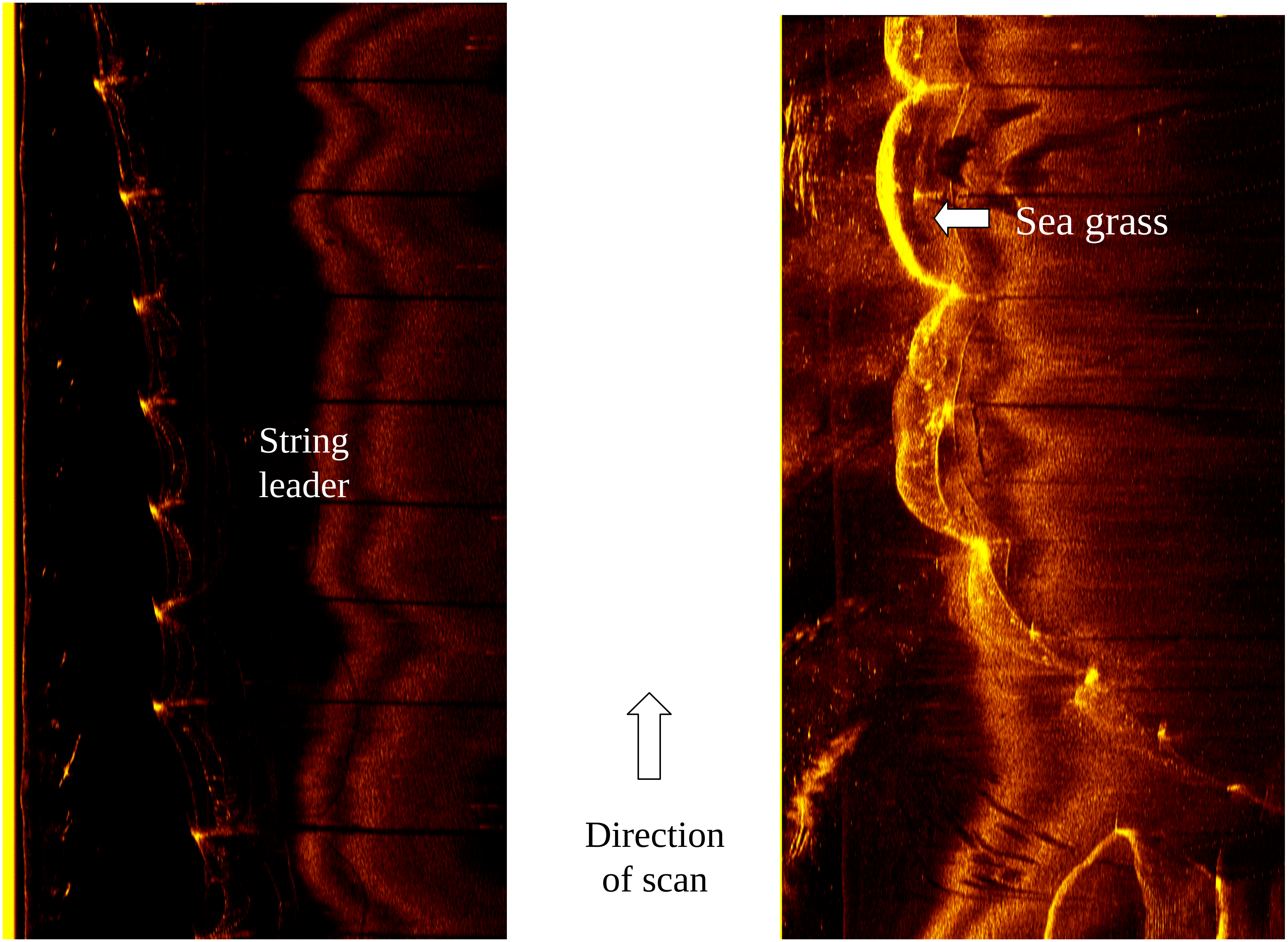
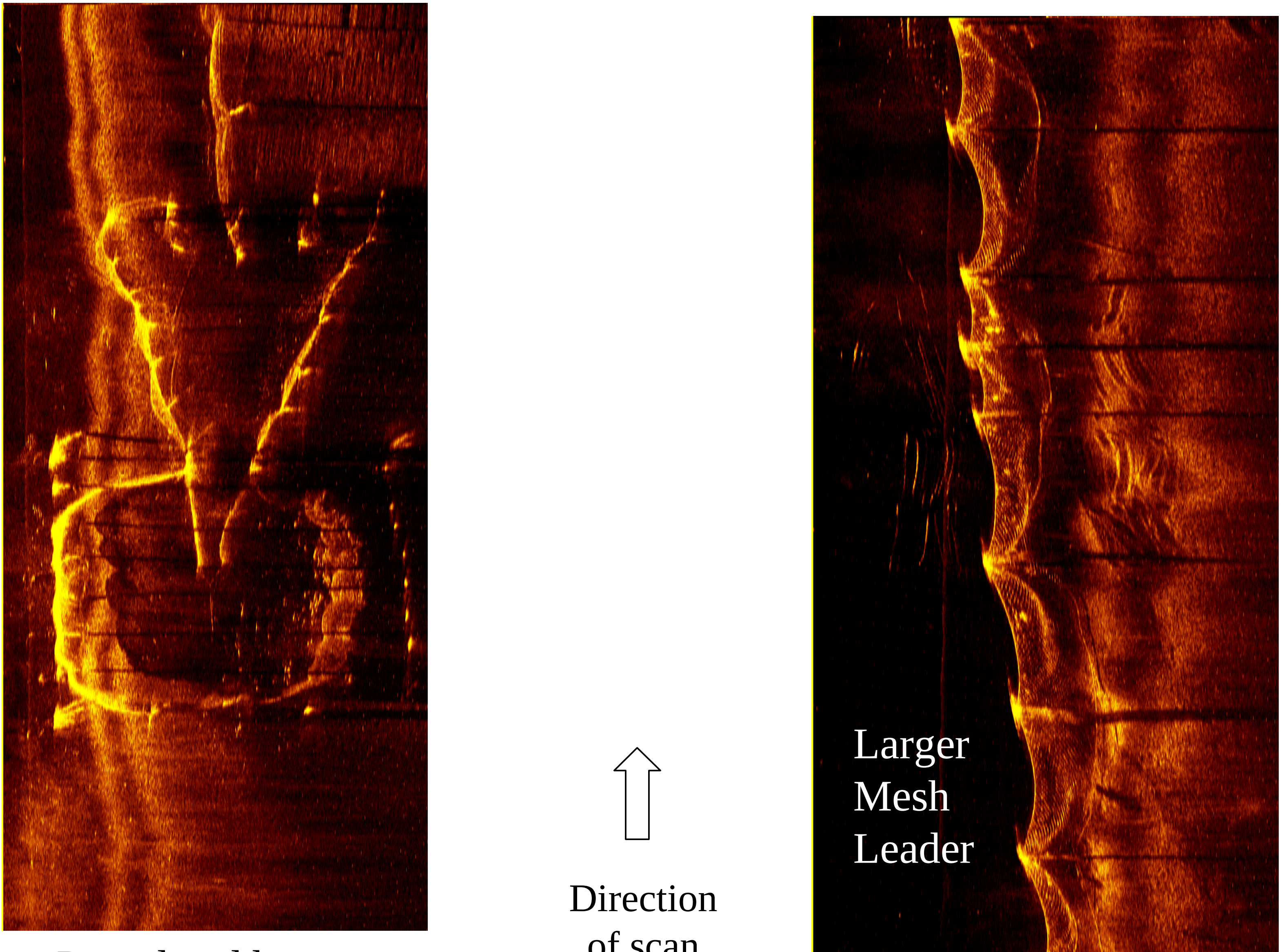


Plate 9. String leader (Western Bay, off Newpoint Comfort) and seagrass accumulation in leader (Eastern Shore, Bay), 2001.

Plate 10. Algal and seagrass clump in poundnet leader, Eastern Shore Bay, 2001

Plate 11. Juvenile sandbar shark incidentally caught in poundnet leader, southern tip of Eastern Shore



Pound and heart

Plate 12. Side scan sonar image (900 KHz) of poundnet leader and heart, large mesh leader, Western Bay, 2001

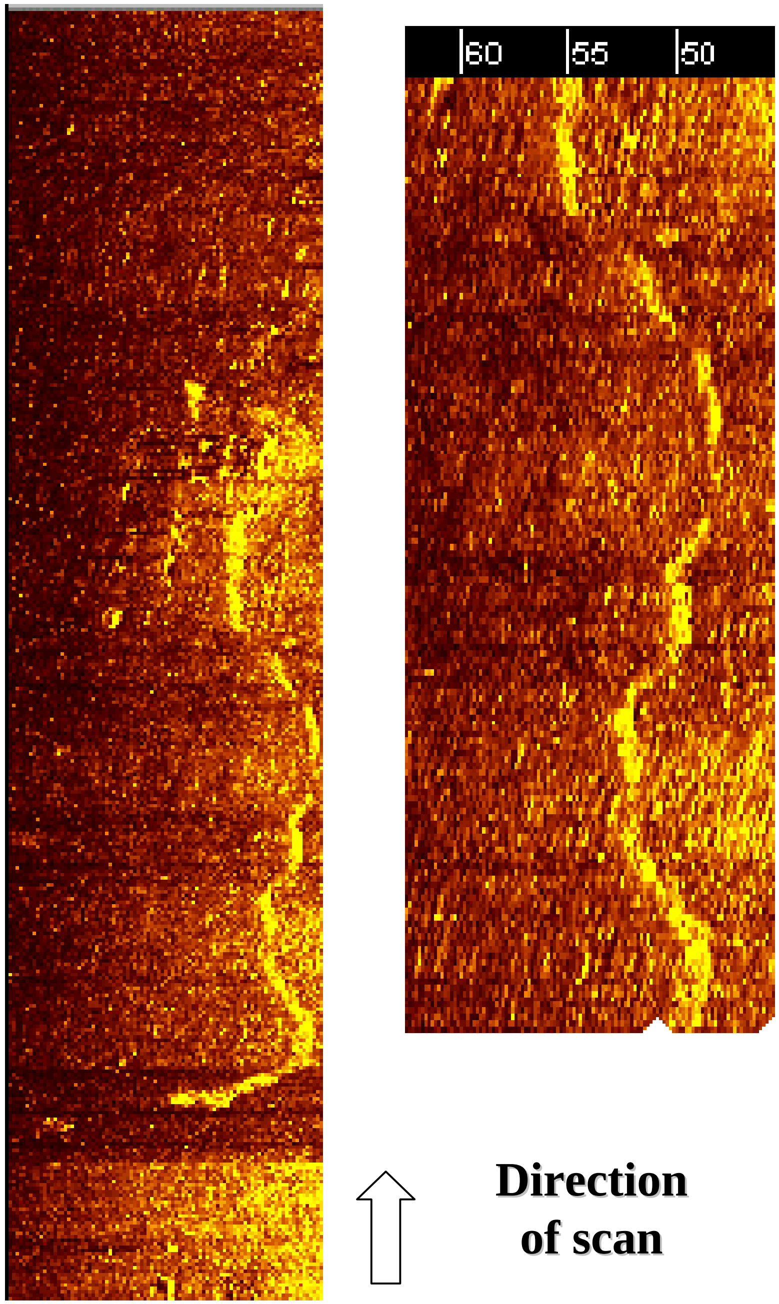


Plate 13. Side scan sonar profile (using a 600 KHz sonar) of gillnet, lower Chesapeake Bay. Image courtesy of R. Gammisch.

APPENDICES

APPENDIX A. Excel file of mainstem Chesapeake Bay, Virginia poundnet locations and data from 2001 survey, June-October, 2001.

PoundNetID	Licence#	Location	Region	PoundLat	PoundLong	PoundDepth	ındnetStatusC	LeaderLat(E)	LeaderLong(E)	Leader(E)Depth	LeaderType	LeaderStatusCode	NumberPoles
147	2001-???	N of reedville, inshore	WB	37.814	-76.260	12	4	37.816	-76.262	4	1	1	129
153	2001-11	n of reedville	WB	37.753	-76.243	17	1	37.821	-76.245	14	1	1	136
109	2001-117	South of Garden Creek	WB	37.428	-76.248		1	37.427	-76.252	1	1	1	63
108	2001-124	South end of Gwynn's Island, Bay side (E)	WB	37.492	-76.263		1	37.49	-76.267	13	1	1	122
105	2001-125	South of Rappahannock mouth	WB	37.550	-76.287	19	1	37.552	-76.29	15	3	1	66
106	2001-126	South of Piankatank mouth (Piank. Side of Gwynn's Island)	WB	37.147	-76.309	18	1	37.515	-76.305	3	1	1	48
107	2001-128	East side Gwynn's Island, half way down south end	WB	37.502	-76.269	18	1	37.5	-76.272	8	1	1	67
137	2001-140	n of kiptopeke	ES-Bay	37.232	-76.026	17	1	37.233	-76.021	10	1	1	58
123	2001-149	S of Kipto, inshore (N or resort beach)	ES-Bay	37.139	-75.975	5	1	37.139	-75.974	2	4	1	0
151	2001-15	n of reedville, offshore	WB	37.807	-76.255	17	1	37.809	-76.258	14	1	1	133
116	2001-151	4th net s. of Kiptopeke SP (off shore)	ES-Bay	37.152	-75.000	987	30	37.153	-75.984	22	1	1	34
117	2001-152	S of Kipto. SP	ES-Bay	37.156	-75.980	12	1					2	
120	2001-153	S of Kiptopeke SP, inshore in front of white house and tower	ES-Bay	37.146	-75.978	10	1	37.147	-75.975	0	4	1	105
119	2001-154	S of Kipto, offshore, s of tower and 4 houses	ES-Bay	37.143	-75.984	31	1	37.144	-75.981	22	1	1	32
126	2001-155	S of Kiptopeke; second to last net before ES tip	ES-Bay	37.125	-75.976	5	1	37.125	-75.973	4	4	1	84
144	2001-157	s shore of creek	ES-Bay	37.618	-75.898		2					2	
143	2001-158	N shore of creek	ES-Bay	37.626	-75.887	4	2						
115	2001-165	3rd net south of Kipto SP, inshore	ES-Bay	37.160	-75.982	12	1	37.161	-75.98	0	1	1	57
131	2001-166	2nd net (inshore) n of kiptopeke	ES-Bay	37.175	-75.992	8	1	37.176	-75.986	2	1	1	63
114	2001-168	Just south of Kipto. SP, behind/inshore of 1st net	ES-Bay	37.162	-75.985	13	1	37.163	-75.983	0	1	1	45
130	2001-171	First net N of Kiptopeke SP	ES-Bay	37.130	-75.997	9	1				1	1	47
121	2001-172	S of Kiptopeke	ES-Bay	37.141	-75.981	26	1	37.141	-75.978	11	1	1	36

MeshStretch (cm)	MeshK-K (cm)	Time	SurveyDate	SeaState	Weather	Notes
10	5	11:50:00 AM	8/2/2001	<1	sunny, clear	Mesh ended at 127; dbl pound; heart and pound 1"; ++ algae and grass ar surface of lead
15	10	1:24:00 PM	8/2/2001	<1	sunny, clear	grass in clumps at surface; poles set 5-6 feet apart
5	2.5	11:14:00 AM	6/8/2001	<1	sunny, clear	Some haze; double heart, no mesh on second; 3-4 minutes per SSS tow @ 1.5-3.3 kts; horseshoe crabs in pound; 1" pound mesh; leader net only on poles 1-35, 36-44, rest to shore no net
15	10	10:49:00 AM	6/8/2001	<1	sunny, clear	Haze; double heart w/ 2-3" mesh; SSS tows took 4 min per side @ 1.9-3.0 kts; upcurrent side towed first
		9:45:00 AM	6/8/2001	<1	sunny, clear	Some haze; 1m depth sss (900 khz), tow@ 3.1 kts, 10-15 m off net; two possible hits, one was a buoy, other not turtle
15	10	10:10:00 AM	6/8/2001	<1	sunny, clear	Haze; 11 poles from heart before mesh visible, last 3 poles, no net @ end of lead; stringer heart; tow SSS @ 3.2 kts, 4 minutes per side; 1" pound mesh
15	10	10:32:00 AM	6/8/2001	<1	sunny, clear	Some haze; tide moving N; pole 20 @ angle, poles 50-51 has stringer between poles, 54-55 net bunched up in line; SSS south side first, tow took about 4 minutes per side; heart same mesh as lead, pound 1" mesh
	15	10:43:00 AM	8/1/2001	1-2	sunny, clear	heart 6-8"; smaller leader (4-6"); pound full of fish (anchovies?); rockweed present throughout leader: poles 14/15, 24, 29 (including balloon string). 31 = crossover, 49 end net
	8	1:42:00 PM	7/23/2001	1-2	cloudy	dead ray floating into outside of heart; one side scanned only, leader ends at shore; small mesh leader
15	10	12:38:00 PM	8/2/2001	<1	sunny, clear	cormorant caught in pound (eventually escaped); some grass in leader; +++ fish in area based on sonar scan
	15	12:19:00 PM	7/23/2001	<1	partly cloudy	#9/10 double pole; 20-21 large gap; 27/28 large clump of detritus; down current side first
			7/23/2001	<1	partly cloudy	no leader, five sets of two poles--run to shore (possible buoy leader)
		1:11:00 PM	7/23/2001	1-2	cloudy	mesh not visible (small); scanned one side only ++ rock week in net
	20	12:52:00 PM	7/23/2001	1-2	partly cloudy	pole 9 at angle; 19-20 hit; 18-17 hit (all algae/rock weed); 23-24 hit (same)
15	10	1:58:00 PM	7/23/2001	1-2	partly cloudy	7 sharks caught incidentally--one in heart, rest in lead; also two dead fish in lead' 84 buoys total
		3:28:00 PM	8/1/2001	1-2	sunny, clear	Not active
		3:21:00 PM	8/1/2001	1-2	sunny, clear	Not active
	20	12:05:00 PM	7/23/2001	<1	partly cloudy	leader runs to shore; #27-28= grass; 45-50= large grass clumps at surface; last 11 poles= large mesh; one side scanned only
15	8	3:19:00 PM	7/23/2001	1-2	partly cloudy	Net to shore; ran upcurrent side only
15	10	11:52:00 AM	7/23/2001	<1	partly cloudy	Upcurrent side scanned only; poles to shore; net blanketed in 'cabbage' algae
15	10	3:09:00 PM	7/23/2001	1-2	partly cloudy	dead fish half way down leader, floating; wind picking up; no net to 14th pole (at least visible)
	15	1:21:00 PM	7/23/2001	1-2	cloudy	pole 4 grass clump; 6-10 and 23-end same; ++ grass accumulation; several broken poles

113	2001-174	Eastern Shore Bay, S of kiptopeke	ES-Bay	37.160	-75.991	34	1	37.161	-76.988	20	1	1	69
129	2001-177	Fishermans Island	ES-Bay	37.103	-75.981	8	1	37.103	-75.979	0	4	1	28
127	2001-178	Last net S of Kiptopeke before tip of ES (inshore net)	ES-Bay	35.123	-75.972	4	1	35.123	-75.97	2	4	1	56
140	2001-181	n of Nassawaddox creek and tower	ES-Bay	37.493	-75.956	2	1	37.492	-75.961	1	4	1	52
142	2001-182	Silver beach, north of tower	ES-Bay	37.522	-75.952	6	1	37.522	-75.951	2	4	1	51
154	2001-193	N of reedville	WB	37.821	-76.246	14	1	37.823	-76.248	12	1	1	93
175	2001-198	plantation house net in Rapp	WB	37.577	-76.354		1			5	1	1	
104	2001-198	Rappahannock, in front of plantation home	WB	37.576	-76.354	12	1	37.575	-76.355	3	1	1	67
122	2001-208	S of Kipto, offshore (off beach resort)	ES-Bay	37.138	-75.983	29	1	37.138	-75.98	22	1	1	37
159	2001-21	s of smith point	WB	37.852	-76.283	20	1	37.853	-76.241	14	1	1	102
145	2001-22	1st net N of Reedville	WB	37.806	-76.274	16	1	37.809	-76.277	5	3	1	95
161	2001-24	s of smith pt	WB	37.862	-76.230	26	1	37.863	-76.233	21	1	1	88
160	2001-25	s of smith point	WB	37.856	-76.235	21	1	37.859	-76.238	17	1	1	92
164	2001-27	s of smith point	WB	37.870	-76.234	12	1	37.87	-76.231	21	1	1	92
158	2001-28	s of smith point	WB	37.848	-76.242	17	1	37.848	-76.245	5	1	1	67
167	2001-3	s of smith point	WB	37.879	-76.217	15	1	37.88	-76.221	12	1	1	115
155	2001-30	n of reedville	WB	37.863	-76.236	21	1	37.836	-76.234	20	1	1	76
157	2001-31	s of smith point	WB	37.846	-76.237	25	1	37.846	-76.239	20	1	1	79
156	2001-34	s of smith pt, inshore	WB	37.842	-76.240		2						
152	2001-35	n of reedville, offshore	WB	37.806	-76.252	20	1	37.807	-76.254	17	1	1	93
165	2001-37	s of smith point	WB	37.878	-76.230	13	1	37.878	-76.234	10	1	1	74
163	2001-39	s of smith pt	WB	37.876	-76.236	5	1			5	1	1	32
150	2001-4	n of reedville	WB	37.812	-76.248	18	1	37.814	-76.25	16	1	1	72
146	2001-40	n of reedville (inshore)	WB	37.811	-76.266	11	1	37.813	-76.268	5	1	1	125
168	2001-41	Mouth of channel from Reedville	WB	37.792	-76.259	16	1	37.708	-76.262	14	1	2	74
166	2001-5	s of smith point	WB	37.874	-76.227	20	1	37.873	-76.224	23	1	1	96

	20	11:21:00 AM	7/23/2001	<1	partly cloudy	++grass/fragmites clumps all along leader and around poles; leader net 4 feet below surface; 18th pole, 15th pole hits but were large clumps of fragmites. ; sss tows 4 min each side
		2:43:00 PM	7/23/2001	1-2	partly cloudy	++ rockweed in nets; 24 poles then rest buoys; upcurrent side first; leader goes to shore; ++ red-brown algae/bryozoan in lead
15	10	2:24:00 PM	7/23/2001	1-2	partly cloudy	15 poles then buoys to end; a black tip, red drum and weakfish all caught in leader. Shark caught by jaw and tail
4	2	2:15:00 PM	8/1/2001	1-2	sunny, clear	Buoy leader witih 1" mesh; leader goes to shore
5	2	2:41:00 PM	8/1/2001	1-2	sunny, clear	++ Jellyfish and algae in net
15	10	1:36:00 PM	8/2/2001	<1	sunny, clear	++ grass at surface of leader; two crab pots near end of leader; mesh ends at pole 87; 1" pound and heart
		12:49:00 PM	8/3/2001	1-2	sunny, clear	surveyed earlier in summer
		9:20:00 AM	6/8/2001	<1	sunny, clear	SSS, 900 KHZ; 10-15 M FROM NET, INCOMING TIDE; possible sss hit in leader, up current side at end of bottom half; pound mesh 1"
		1:32:00 PM	7/23/2001	1-2	cloudy	sss indicated finer mesh and ++ grass; 21-22= gap in net
15	10	2:19:00 PM	8/2/2001	<1	sunny, clear	++ grass laced iin nets at surface; mesh ends at pole 95
	5	11:10:00 AM	8/2/2001	<1	sunny, clear	++ weed in leader; mesh bunching below stringer; lead changes to mesh last 12 poles' pound and heart 1"
10	5	2:53:00 PM	8/2/2001	<1	sunny, clear	long fish in heart mesh; poles 6-7 ft apart
15	10	2:31:00 PM	8/2/2001	<1	sunny, clear	double pound (1" pn and ht)
15	10	3:05:00 PM	8/2/2001	<1	sunny, clear	grass laced in mesh
10	5	2:11:00 PM	8/2/2001	<1	sunny, clear	poles 60/61 leader blown out with large twist and grass clump
15	10	3:42:00 PM	8/2/2001	1-2	sunny, clear	mesh starts at pole 6; heart mesh blown out at poles; lead mesh attached at surface but blown out below
15	10	1:50:00 PM	8/2/2001	<1	sunny, clear	++ grass in nets--laced throughout
15	10	2:03:00 PM	8/2/2001	<1	sunny, clear	+++ grass in nets; poles set fairly close together; dbl pound, 1" p and h
		2:00:00 PM	8/2/2001	<1	sunny, clear	looks like ready to fish, just no net
15	10	12:50:00 PM	8/2/2001	<1	sunny, clear	north side scanned first; heart in poor repair; mesh size changes at pole 42 (from end)--smaller mesh first (1-2"); water loaded with small baitfish
10	5	3:23:00 PM	8/2/2001	<1	sunny, clear	holes torn in net at every pole; one side scanned only
10	5	3:15:00 PM	8/2/2001	<1	sunny, clear	+++ grass mats in net; few poles larger than others (fatter); pole 4 floating at surface, large gap between 26-27
15	10	12:24:00 PM	8/2/2001	<1	sunny, clear	net not clear on scan; dbl pound; pound and heart 1"
10	5	11:30:00 AM	8/2/2001	<1	sunny, clear	many poles leaning at angle; ++ weed on top of net, many holes in net; pole 69 log at surface, 99 broken pole; mesh ends at 121; small blue crabs stuck in leader
		9:43:00 AM	8/3/2001	1-2	sunny, clear	leader not hung
30	15	3:31:00 PM	8/2/2001	1-2	sunny, clear	change in mesh at pole 35 to smaller (15, 10)

162	2001-6	s of smith pt	WB	37.868	-76.234		1	37.869	-76.237	10	1	1	74
149	2001-7	n of reedville, offshore	WB	37.815	-76.251	15	1	37.816	-76.254	14	1	1	102
170	2001-73	mouth of Rappahannock (1st inside mouth)	WB	37.604	-76.277	18	1	37.606	-76.276	4	1	1	47
172	2001-75	n shore, rapp river	WB	37.607	-75.291	19	1	37.609	-76.29	9	1	1	58
174	2001-76	N shore of Rapp	WB	37.616	-76.308	16	1	37.618	-76.307	5	1	1	61
148	2001-8	n of reedville, inshore	WB	37.813	-76.255	14	1	37.817	-76.257	11	3	1	108
173	2001-85	n shore of rapp, west of windmill pt	WB	37.614	-76.296	16	1	37.616	-76.294	4	1	1	87
171	2001-86	n side of Rapp. Mouth	WB	37.599	-76.268	23	1	37.602	-76.267	6	1	1	66
169	2001-87	Little Bay	WB	37.644	-76.320	18	1	37.642	-76.318	3	1	1	73
118	2001-NO	S of Kipto. SP, inshore in front of three houses on bluff	ES-Bay	37.150	-75.979		2						
128	2001-OLD	Southern most stand (not active) on ES, Bay	ES-Bay	37.119	-75.972	4	2			0			
124	2001-old	s of kiptopeke and resort	ES-Bay	37.134	-75.982		2					2	
125	2001-old	s of kiptopeke, close to ES tip	ES-Bay	37.125	-75.980	26	2					2	
132	2001-OLD	3rd stand N of Kiptop.	ES-Bay	37.179	-75.995		2					2	
133	2001-OLD	N of Kiptopeke	ES-Bay	37.183	-75.998		2					2	
134	2001-OLD	5th stand N of Kiptopeke	ES-Bay	37.187	-75.001		2					2	
135	2001-OLD	N of Kipto. And brown house	ES-Bay	37.193	-76.008		2					2	
138	2001-OLD	Outside Nassawaddox Creek	ES-Bay	37.479	-75.965		2					2	
139	2001-OLD	Outside Nassawaddox creek	ES-Bay	37.479	-75.965		2				2		
141	2001-OLD	Silver Beach, north of tower	ES-Bay	37.515	-75.956		2				2		
136	2001-OLD	n of kipto and tower	ES-Bay	-37.190	-76.005		2				2		
110	2001-WCB1	Off Newpoint	WB	37.308	-76.226	33	1	37.309	-76.23	34	3	1	53
111	2001-WCB2	Off Newpoint (inshore of two outer nets)	WB	37.308	-76.225	34	1	37.31	-76.235	27	3	1	85
112	2001-WCB3	Inshore net off Newpoint	WB	37.319	-76.257	16	1	37.321	-76.26	4	3	1	64

15	10	3:56:00 PM	8/2/2001	<1	sunny, clear	crab pot towards end of leader--turned to avoid when scanning; mesh ends at pole 59
15	10	12:14:00 PM	8/2/2001	<1	sunny, clear	++ grass in lead; double pound (1"), stringer heart at surface, mesh 2' below (1-2" both)
15	10	11:32:00 AM	8/3/2001	1-2	sunny, clear	crab pot buoy between last two poles
15	10	12:01:00 PM	8/3/2001	1-2	sunny, clear	2.2 kt scan; dbl pound w/ 1" heart and pound
10	5	12:24:00 PM	8/3/2001	1-2	sunny, clear	mesh ends at 47; net extends close to shore; pole 37 = change/overlap in mesh; 2.2 kt scan
15	10	12:05:00 PM	8/2/2001	<1	sunny, clear	leader changes to stringer at pole 50 (6-8") to end; +++ grass in leader; crab pot buoy in net (pole 16); dbl pound
10	5	12:12:00 PM	8/3/2001	1-2	sunny, clear	net goes to shore
15	2	11:46:00 AM	8/3/2001	1-2	sunny, clear	dbl pound; 1" heart and pound mesh
15	10	10:48:00 AM	8/3/2001	1-2	sunny, clear	leader mesh changes to 1" at end; mats of grass throughout lead
			7/23/2001	1-2	partly cloudy	old stand
		2:33:00 PM	7/23/2001	1-2	partly cloudy	not active, poles go to shore
			7/23/2001	1-2	cloudy	old stand, no license
			7/23/2001	1-2	cloudy	no license, old stand
		3:27:00 PM	7/23/2001	1-2	partly cloudy	not active
		3:29:00 PM	7/23/2001	1-2	partly cloudy	not active
		3:31:00 PM	7/23/2001	1-2	partly cloudy	not active
		3:34:00 PM	7/23/2001	1-2	partly cloudy	
			8/1/2001	1-2	sunny, clear	Not active
			8/1/2001	1-2	sunny, clear	Not active; old license: 2000-169
			8/1/2001	1-2	sunny, clear	Not active
		3:33:00 PM	7/23/2001	1-2	partly cloudy	not active
		11:45:00 AM	6/8/2001	<1	sunny, clear	Stringers set ~5"; strong flood tide; 3-4 minutes per tow side; stringer heart, 1" pound mesh (2001-WalterColes SSS file name)
		11:48:00 AM	6/8/2001	<1	sunny, clear	Stringers set ~5" apart; 4-5 minutes per SSS tow side; string heart, 1" pound mesh (2001-WalterColes in sss files--two nets scanned in this file); last three poles, no net, between 21-22 garbage bag)
		12:18:00 PM	6/8/2001	<1	sunny, clear	Stringers set 4-5" apart; up current side SSS tow first, 4 minutes per side; poles 55-56 box floating @ surface; 1" pound mesh

Appendix B. Season and Time Restrictions for Virginia Gillnet Fisheries (From VMRC Website: "Summary of Gill Net Laws and Regulations for Virginia Tidal Waters)

* From January 1 through March 25, it is unlawful to set or fish gill nets with stretched mesh size between 3 3/4" and 6" within the restricted areas set forth below. From March 26 through June 15, it is unlawful to set or fish gill nets with stretched mesh size greater than 6" with the restricted areas set forth below.

<u>James River</u>: Upstream of a line connecting Willoughby Spit and Old Point Comfort
<u>Back River</u>: Upstream of a line connecting Factory Point and Plumtree Point.
<u>Poquoson River</u>: Upstream of a line connecting Marsh Point and Tue Point.
<u>York River</u>: Upstream of a line connecting Tue Point and Guinea Marshes.
<u>Mobjack Bay</u>: Upstream of a line connecting Guinea Marshes and New Point Comfort.
<u>Milford Haven</u>: Upstream of a line connecting Rigby Island and Sandy Point.
<u>Piankatank River</u>: Upstream of a line connecting Cherry Point and Stingray Point.
<u>Rappahannock River</u>: Upstream of a line connecting Stingray Point to Windmill Point.
[4VAC20-751-10 ET SEQ.]

* From April 1 through May 31, the spawning reaches of the James, Pamunkey, Mattaponi and Rappahannock Rivers are closed to stake and anchor gill nets. Drift or float gill nets may be set and fished in these areas, provided that the gill netter remains with the net while it is fishing and all striped bass caught must be returned to the water immediately [4VAC20-252-10 ET. SEQ.].

* From May 1 through June 7 and during the hours of 7:00 A.M. to 8:30 P.M., it is unlawful to set or fish any gill nets or trotlines within the Special Lower Bay (Cabbage Patch) Management Area (see Reg. 4VAC20-320-10 ET SEQ. for defined boundary lines).

* From May 15 through September 15, it is unlawful to set or fish any gill net within 400' of the shoreline in the area bounded by the Hampton Roads Bridge-Tunnel eastward to Cape Henry and south to the southern oceanfront boundary of the U.S. Dam Neck Military Base [4VAC20-680-10 ET SEQ.].

* The closed seasons on harvesting grey trout by gill net are May 14 through October 7 and December 18 through March 31; however up to 150 pounds of grey trout 12" or greater in length may be possessed [4VAC20-380-10 ET SEQ.].

* From the Friday preceding Memorial Day through Labor Day and from 7:00 A.M. to 5:00 P.M., it is unlawful to set or fish any gill nets within the Hampton Roads Management Area (see Reg. 4VAC20-470-10 ET SEQ. for defined boundary lines).

* From the Friday before Memorial Day through September 15, unimpeded breaks of 500' between adjacent rows of gill nets are required along the southern oceanfront boundary of the U.S. Dam Neck Military Base south to the North Carolina border. Gaps between such gill nets in the same row shall occur no less than every 2000' and all gill nets must be set at least 400' seaward from the mean highwater mark [Code 28.2-308].

* From June 1 through October 31, it is unlawful to set or fish any gill nets in the Eastern Shore Bayside Management Areas (see Reg. 4VAC20-480-10 ET SEQ. for defined boundary lines).

* From December 1 through April 30, it is unlawful to use a haul seine, gill net, or stationary net of any kind in Broad or Linkhorn Bays [4VAC20-10-10 ET SEQ.].

Appendix C. Gear Restrictions for Virginia Gillnet Fisheries (From VMRC Website: “Summary of Gill Net Laws and Regulations for Virginia Tidal Waters).

* No gill net may exceed 1200' in length [Code 28.2-301, 28.2-307].

* Gill net minimum stretched mesh size is 2 7/8". One exception is that mullet nets (less than 200 yards) may have a minimum stretched mesh size of 2", with a 15% allowance of the total daily catch (by weight) for other species. A second exception is that from February 1 through April 30, gill nets may have a minimum stretched mesh size of 2", only for the harvest of river herring in the areas described in DRIFT GILL NET FISHERY EXEMPTION [Code 28.2-305, Reg. 4VAC20-430-60].

* A mullet gill net may be no deeper than 40 meshes [Code 28.2-305].

* Any gill net not assigned a fixed location must be set in a straight lne, have no greater depth than 330" and shall be fished no closer than 200' to any other such gill net. Exception - the 200' distance does not apply to those gill nets not assigned a fixed location which are set and fished in the Chesapeake Bay tributaries [4VAC20-220-10 ET SEQ.].

* A staked gill net, which is a fixed fishing device and is assigned to a fixed location, shall be perpendicular to the shoreline insofar as possible [4VAC20-20-10 ET SEQ.]

* No gill net shall be set or fished within 300 feet of any bridge, bridge-tunnel, jetty or pier during any open recreational striped bass season, except from midnight Sunday through midnight Wednesday (see Reg. 4VAC20-252-10 ET SEQ. for details of the open striped bass recreational seasons).

* No gill net shall be set or fished within 250 yards of the Chesapeake Bay Bridge Tunnel, or within 300 yards of any commercial fishing pier [Code 28.2-302, Reg. 4VAC20-80-10 ET SEQ.].

* A 200' space is required between successive fishing structures in the same row and 300 yards between adjoining rows. A 200' wide clear passageway is required from all navigable channels to all established boat landings. No gill net may be set or fished within 300 yards of any fixed fishing device, unless it is in the same row [Code 28.2-307].

* It is unlawful to fish a net across a body of water that is longer than one-fourth the width of the body of water at mean low water [Code 28.2-309].

* It is unlawful to fish nets in any portion of a marked channel, except that this does not apply to the seaside of Eastern Shore [Code 28.2-309].

* It is unlawful to set or fish any net which is a hazard to navigation [Code 28.2-309].

* No gill net shall be set or fished within 500 yards below the Chickahominy Dam at Walker's, on the Chickahominy River [Code 28.2-311].

* Stakes or poles used to support gill nets must project at least 4' above the surface of the water at all stages of the tide, and all abandoned poles must be removed, except that one may be left standing as an identification marker [Code 28.2-307, 28.2-237].

* It is unlawful to set any gill net and let the net remain unfished [4VAC20-170-10 ET SEQ., 4VAC20-550-10 ET SEQ.].

- It is unlawful to set, fish or have in the water any gill net closer than 200 yards to the buoys marking certain artificial reefs, including the Anglers Reef, the Cell Reef, the Gwynn Island Reef and the Northern Neck Reef (see Reg. 4VAC20-755-10 ET SEQ. for further details).

APPENDIX D. Fish species landed by Virginia gillnet fishery, May through October 2001. Data courtesy of VMRC (based on available data at time of writing).

[1] Landed during May – July 2001
[2] Landed during August – October 2001

SPECIES	SCIENTIFIC NAME
Alewife[1, 2]	*Alosa pseudoharengus*
Striped Bass[1, 2]	*Morone saxatilis*
Bluefish[1, 2]	*Pomatomus saltatrix*
Bonito[2]	*Sarda sarda*
Butterfish[1, 2]	*Peprilus triacanthus*
Carp[1, 2]	*Cyprinus carpio carpio*
Catfish[1, 2]	*Ictalurus* sp.
Cobia[1, 2]	*Rachycentron canadum*
Conch, Unclassified[1, 2]	N/A
Crab, blue[1, 2]	*Callinectes sapidus*
Crab, horseshoe[1]	*Limulus polyphemus*
Croaker, Atlantic[1, 2]	*Micropogonias undulatus*
Dogfish, Unclassified[1, 2]	N/A
Dogfish, Smooth[1, 2]	*Mustelus canis*
Dogfish, Spiny[1]	*Squalus acanthias*
Drum, Black[1, 2]	*Pogonias cromis*
Drum, Red[1, 2]	*Scianops ocellatus*
Eel, American[1, 2]	*Anguilla rostrata*
Eel, Conger[1, 2]	*Conger oceanicus*
Fish, Other[1, 2]	N/A
Flounder, Summer[1, 2]	*Paralichthys dentatus*
Garfish[2]	*Belone belone belone*
Harvestfish[1, 2]	*Peprilus alepidotus*
Herring, Atlantic[1]	*Clupea harengus*
Makerel, Atlantic[1, 2]	*Scomber scombrus*
Makerel, King[2]	*Scomberomorus cavalla*
Makerel, Spanish[1, 2]	*Scomberomorus maculatus*
Menhaden, Atlantic[1, 2]	*Brevoortia tyrannus*
Minnow[1]	Family *Cyprinidae*
Mullet[1, 2]	*Mugil* sp.
Perch, White[1, 2]	*Morone americana*
Perch, Yellow[1, 2]	*Perca flavescens*
Pompano, Common[2]	*Trachinotus carolinus*
Puffer, Northern[1, 2]	*Sphoeroides maculatus*

Scup[2]	*Stenotomus chrysops*
Seabass, Black[1, 2]	*Centropristis striata*
Seatrout, Gray (Weakfish)[1, 2]	*Cynoscion regalis*
Seatrout, Spotted[1, 2]	*Cynoscion nebulosus*
Shad, Gizzard[1, 2]	*Dorosoma cepdianum*
Shad, Hickory[1, 2]	*Alosa mediocris*
Shark, Unclassified[1, 2]	N/A
Shark, Large Coastal[2]	N/A
Shark, Blacktip[1, 2]	*Carcharhinus limbatus*
Shark, Dusky[1, 2]	*Carcharhinus obscurus*
Shark, Lemon[1, 2]	*Negaprion brevirostris*
Shark, Porbeagle[1]	*Lamna nasus*
Shark, Sandbar[1, 2]	*Carcharhinus plumbeus*
Shark, Sand Tiger[1, 2]	*Odontaspis taurus*
Shark, Thresher[1, 2]	*Alopias vulpinus*
Shark, White[1, 2]	*Carcharodon carcharias*
Sheepshead[1]	*Archosargus probatocephalus*
Skate, Unclassified[1]	N/A
Spadefish[1, 2]	*Cheatodipterus faber*
Spot[1, 2]	*Leiostomus xanthurus*
Tautog[1, 2]	*Tautoga onitis*
Tuna, Albacore[1, 2]	*Thunnus alalunga*
Tuna, False Albacore[1, 2]	*Euthynnus alletteratus*
Whiting, King (Kingfish)[1, 2]	*Menticirrhus* sp.

APPENDIX E. Aerial sightings of crab pots, commercial fishing boats, and recreational fishing boats, June-October 2001.

Codes:
CP = Crab pot
CB = Crab boat
CP-B = Crab pots from beginning of transect to time indicated
CP-E = Crab pots from time indicated to end of transect
CR = Crab boat (dual listing)
DISTANCE = Distance in meters of object from transect
RFISH = Recreational fishing boat (hook and line)
CFISH = General commercial fishing boat
MH = Menhaden boat
Pots = Unidentified pots
TR = Trawler
OYD = Oyster dredge
CD = Crab dredge
GB = Gillnet boat

DATE	OBSERVER	REGION	TRANSECT	CATEGORY	DISTANCE (m)	COMMENTS
12-Jun	1	Upper Bay	56	MH	9.16	
12-Jun	2	Upper Bay	56	MH	9.00	
12-Jun	1	Upper Bay	56	MH	10.58	
12-Jun	1	Upper Bay	56	CR	11.16	
12-Jun	1	Upper Bay	56	CP	19.47	
12-Jun	1	Upper Bay	56	CP-E	40.84	
12-Jun	1	Upper Bay	53	CP-B	7.42	
12-Jun	1	Upper Bay	53	CP	21.89	
12-Jun	1	Upper Bay	53	CP-E	52.37	
12-Jun	1	Upper Bay	45	CP-B	4.55	
12-Jun	1	Upper Bay	45	CR	5.10	
12-Jun	1	Upper Bay	32	MH	14.20	
12-Jun	1	Lower Bay	21	CP-B	10.05	
12-Jun	1	Lower Bay	19	CP-E	26.84	
12-Jun	1	Lower Bay	14	CP-B	3.42	
12-Jun	1	Lower Bay	14	CB	7.79	
19-Jun	1	Lower Bay	22	CP-B	2.70	
19-Jun	1	Lower Bay	22	CP-E	20.30	
19-Jun	1	Upper Bay	49	CP-E	40.42	
26-Jun	2	Lower Bay	13	CB	1.25	
26-Jun	2	Lower Bay	13	CP	1.25	
26-Jun	1	Lower Bay	13	CP-B	1.55	
26-Jun	2	Lower Bay	13	CP	2.75	
26-Jun	2	Lower Bay	13	RFISH	4.75	
26-Jun	1	Lower Bay	13	CB	7.60	
26-Jun	2	Lower Bay	13	RFISH	26.70	
26-Jun	2	Lower Bay	13	RFISH	26.70	

26-Jun	2	Lower Bay	13	RFISH	26.70
26-Jun	2	Lower Bay	13	RFISH	26.70
26-Jun	2	Lower Bay	13	RFISH	26.70
26-Jun	2	Lower Bay	19	RFISH	1.50
26-Jun	1	Lower Bay	19	CP-B	25.75
26-Jun	2	Lower Bay	19	RFISH	26.65
26-Jun	1	Lower Bay	19	RFISH	28.20
26-Jun	1	Lower Bay	19	RFISH	28.20
26-Jun	1	Lower Bay	19	RFISH	28.20
26-Jun	1	Lower Bay	19	RFISH	28.20
26-Jun	1	Lower Bay	19	RFISH	28.20
26-Jun	1	Lower Bay	19	RFISH	28.20
26-Jun	1	Lower Bay	19	CB	30.90
26-Jun	2	Lower Bay	19	MH	32.85
26-Jun	2	Lower Bay	19	MH	32.85
26-Jun	1	Lower Bay	19	CB	37.15
26-Jun	2	Lower Bay	19	RFISH	37.65
26-Jun	2	Lower Bay	19	RFISH	37.65
26-Jun	2	Lower Bay	19	RFISH	37.65
26-Jun	2	Lower Bay	24	CP	1.09
26-Jun	1	Lower Bay	24	CB	0.78
26-Jun	2	Lower Bay	24	CB	6.30
26-Jun	2	Lower Bay	24	CP	6.30
26-Jun	2	Lower Bay	24	CP	11.65
26-Jun	1	Lower Bay	24	CP-B	13.09
26-Jun	1	Lower Bay	24	RFISH	28.83
26-Jun	1	Lower Bay	24	RFISH	28.83
26-Jun	1	Lower Bay	24	RFISH	28.83
26-Jun	1	Lower Bay	28	CP	2.00
26-Jun	2	Lower Bay	28	CP-B	4.74
26-Jun	2	Lower Bay	28	RFISH	22.63
26-Jun	2	Lower Bay	28	RFISH	22.63
26-Jun	2	Lower Bay	28	RFISH	22.63
26-Jun	2	Lower Bay	28	CP	26.00
26-Jun	1	Lower Bay	28	CP	26.10
26-Jun	2	Lower Bay	28	CP	27.10
26-Jun	2	Lower Bay	28	CP	41.26
26-Jun	1	Upper Bay	33	CB	2.71
26-Jun	2	Upper Bay	33	CP-B	4.33
26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	RFISH	21.81

26-Jun	2	Upper Bay	33	RFISH	21.81
26-Jun	2	Upper Bay	33	CP	24.81
26-Jun	1	Upper Bay	38	GB	6.10
26-Jun	2	Upper Bay	38	RFISH	6.20
26-Jun	2	Upper Bay	38	RFISH	6.20
26-Jun	2	Upper Bay	38	RFISH	6.20
26-Jun	2	Upper Bay	38	RFISH	21.30
26-Jun	2	Upper Bay	38	RFISH	21.30
26-Jun	2	Upper Bay	38	RFISH	21.30
26-Jun	2	Upper Bay	38	RFISH	21.30
26-Jun	2	Upper Bay	38	RFISH	21.30
26-Jun	2	Upper Bay	38	CP	29.80
26-Jun	2	Upper Bay	46	CP-B	4.67
26-Jun	2	Upper Bay	46	CP	6.43
26-Jun	2	Upper Bay	46	CP	39.05
26-Jun	1	Upper Bay	56	CP-B	9.43
26-Jun	2	Upper Bay	56	CP	20.55
26-Jun	1	Upper Bay	56	CP	21.57
26-Jun	1	Upper Bay	56	CP	29.14
26-Jun	2	Upper Bay	56	CP	30.14
26-Jun	1	Upper Bay	56	CP	31.29
26-Jun	1	Upper Bay	56	CP	34.24
26-Jun	1	Upper Bay	56	CP-E	49.38
26-Jun	2	Upper Bay	56	CP	34.50
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	4	RFISH	14.96
03-Jul	2	Lower Bay	12	RFISH	2.50
03-Jul	2	Lower Bay	12	CB	28.83
03-Jul	2	Lower Bay	12	CP	28.83
03-Jul	2	Lower Bay	13	CB	1.14
03-Jul	1	Lower Bay	13	CP-B	3.48
03-Jul	2	Lower Bay	13	CP	4.59
03-Jul	2	Lower Bay	13	RFISH	8.45
03-Jul	2	Lower Bay	13	RFISH	8.45
03-Jul	2	Lower Bay	13	RFISH	8.45
03-Jul	2	Lower Bay	13	RFISH	8.45
03-Jul	2	Lower Bay	13	RFISH	8.45
03-Jul	2	Lower Bay	29	CB	0.72
03-Jul	2	Lower Bay	29	CB	2.06

03-Jul	2	Lower Bay	29	CP-B	2.56	
03-Jul	2	Lower Bay	29	RFISH	6.11	Many Boats 30+
03-Jul	1	Lower Bay	29	CP-E	21.33	
03-Jul	2	Lower Bay	29	CP-E	23.67	
03-Jul	2	Upper Bay	31	CP	0.76	
03-Jul	1	Upper Bay	31	CP-B	3.00	
03-Jul	2	Upper Bay	31	RFISH	14.43	Many Boats
03-Jul	1	Upper Bay	31	RFISH	16.29	
03-Jul	1	Upper Bay	31	RFISH	16.29	
03-Jul	1	Upper Bay	31	RFISH	16.29	
03-Jul	1	Upper Bay	31	RFISH	16.29	
03-Jul	1	Upper Bay	31	RFISH	16.29	
03-Jul	1	Upper Bay	31	RFISH	16.29	
03-Jul	1	Upper Bay	31	RFISH	16.29	
03-Jul	2	Upper Bay	31	CP	23.43	
03-Jul	1	Upper Bay	31	CP-E	23.71	
03-Jul	2	Upper Bay	34	CP-B	1.65	
03-Jul	1	Upper Bay	34	CP-B	2.58	
03-Jul	2	Upper Bay	34	CP	25.60	
03-Jul	1	Upper Bay	34	CP-E	26.95	
03-Jul	2	Upper Bay	34	CP	27.15	
10-Jul	2	Lower Bay	7	CP	0.29	
10-Jul	1	Lower Bay	7	CP-B	3.10	
10-Jul	2	Lower Bay	7	RFISH	17.43	
10-Jul	2	Lower Bay	7	RFISH	17.43	
10-Jul	2	Lower Bay	7	RFISH	17.43	
10-Jul	2	Lower Bay	7	RFISH	17.43	
10-Jul	2	Lower Bay	7	RFISH	17.43	
10-Jul	2	Lower Bay	7	RFISH	18.62	
10-Jul	2	Lower Bay	7	RFISH	18.62	
10-Jul	2	Lower Bay	14	RFISH	2.91	
10-Jul	2	Lower Bay	14	RFISH	2.91	
10-Jul	1	Lower Bay	14	CP-E	26.14	
10-Jul	2	Lower Bay	14	CB	27.09	
10-Jul	2	Lower Bay	14	CP	27.96	
10-Jul	2	Lower Bay	14	CP	29.36	
10-Jul	2	Lower Bay	14	CP-E	29.55	
10-Jul	2	Lower Bay	15	CP	3.11	
10-Jul	2	Lower Bay	15	CP	4.00	
10-Jul	2	Lower Bay	15	CB	7.26	
10-Jul	1	Lower Bay	15	CP-B	12.21	
10-Jul	2	Lower Bay	15	RFISH	20.32	
10-Jul	2	Lower Bay	15	RFISH	30.63	
10-Jul	2	Lower Bay	15	RFISH	35.10	
10-Jul	2	Lower Bay	15	RFISH	35.10	
10-Jul	1	Lower Bay	15	CP-E	35.63	
10-Jul	2	Lower Bay	28	CP-B	1.50	

10-Jul	2	Lower Bay	28	CB	3.15	
10-Jul	2	Lower Bay	28	CB	3.15	
10-Jul	2	Lower Bay	28	CP	3.15	
10-Jul	1	Lower Bay	28	CP-B	8.16	
10-Jul	2	Lower Bay	28	RFISH	8.70	8 Boats
10-Jul	2	Lower Bay	28	RFISH	10.10	15 Boats
10-Jul	1	Lower Bay	28	CP-E	25.74	
10-Jul	2	Lower Bay	28	CP-E	26.65	
10-Jul	1	Upper Bay	35	CB	1.05	
10-Jul	2	Upper Bay	35	CB	2.84	
10-Jul	2	Upper Bay	35	CP	2.84	
10-Jul	1	Upper Bay	35	CP-B	4.21	
10-Jul	1	Upper Bay	35	MH	7.58	
10-Jul	1	Upper Bay	35	MH	7.58	
10-Jul	1	Upper Bay	35	CP-E	26.79	
10-Jul	2	Upper Bay	35	CP	27.63	
10-Jul	2	Upper Bay	37	CP	2.24	
10-Jul	2	Upper Bay	37	MH	10.90	
10-Jul	1	Upper Bay	37	CP-E	29.00	
10-Jul	2	Upper Bay	37	CP-E	34.76	
10-Jul	2	Upper Bay	41	CP-B	9.90	
10-Jul	1	Upper Bay	41	OYD	12.00	Oyster or Crab Dredge
10-Jul	2	Upper Bay	41	RFISH	10.85	5 Boats
10-Jul	2	Upper Bay	41	CP	15.75	
10-Jul	2	Upper Bay	41	TR	22.00	
10-Jul	1	Upper Bay	41	CP-B	34.85	
10-Jul	2	Upper Bay	41	CP	43.95	
10-Jul	1	Upper Bay	41	CP-E	44.20	
10-Jul	1	Upper Bay	57	CP-B	36.82	
10-Jul	1	Upper Bay	57	CP-E	46.96	
17-Jul	2	Upper Bay	9	RFISH	1.00	
17-Jul	2	Upper Bay	9	RFISH	1.00	
17-Jul	2	Upper Bay	9	CP	2.32	
17-Jul	2	Upper Bay	9	RFISH	11.95	
17-Jul	2	Upper Bay	9	RFISH	11.95	
17-Jul	2	Upper Bay	9	RFISH	24.68	
17-Jul	1	Upper Bay	11	CP-E	26.09	
17-Jul	2	Upper Bay	11	CP-E	26.65	
17-Jul	2	Upper Bay	11	RFISH	27.13	
17-Jul	2	Upper Bay	11	RFISH	27.13	
17-Jul	2	Upper Bay	11	RFISH	29.26	
17-Jul	2	Upper Bay	11	RFISH	29.26	
17-Jul	2	Upper Bay	11	RFISH	29.70	
17-Jul	2	Upper Bay	11	RFISH	29.70	
17-Jul	2	Upper Bay	11	RFISH	29.70	
17-Jul	2	Upper Bay	13	RFISH	0.68	
17-Jul	2	Upper Bay	13	RFISH	0.68	

17-Jul	2	Upper Bay	13	RFISH	0.68	
17-Jul	2	Upper Bay	13	RFISH	0.68	
17-Jul	2	Upper Bay	13	RFISH	0.68	
17-Jul	2	Upper Bay	13	RFISH	2.95	
17-Jul	2	Upper Bay	13	RFISH	2.95	
17-Jul	2	Upper Bay	13	CP	6.05	
17-Jul	1	Upper Bay	13	RFISH	8.42	
17-Jul	1	Upper Bay	13	RFISH	8.42	
17-Jul	1	Upper Bay	13	RFISH	8.42	
17-Jul	2	Upper Bay	30	RFISH	2.14	
17-Jul	2	Upper Bay	30	RFISH	7.36	
17-Jul	2	Upper Bay	30	RFISH	7.36	
17-Jul	1	Upper Bay	30	RFISH	8.77	19 Boats Anchored
17-Jul	2	Upper Bay	30	RFISH	8.68	
17-Jul	2	Upper Bay	30	RFISH	8.68	
17-Jul	2	Upper Bay	30	RFISH	8.68	
17-Jul	2	Upper Bay	30	RFISH	17.82	
17-Jul	2	Upper Bay	30	CP-E	22.23	
17-Jul	2	Upper Bay	39	CP	0.89	
17-Jul	2	Upper Bay	39	RFISH	2.63	
17-Jul	2	Upper Bay	39	RFISH	2.63	
17-Jul	2	Upper Bay	39	CFISH	4.58	
17-Jul	2	Upper Bay	39	CFISH	4.58	
17-Jul	2	Upper Bay	39	CFISH	4.58	
17-Jul	2	Upper Bay	39	CP	4.58	
17-Jul	2	Upper Bay	39	CFISH	6.53	
17-Jul	1	Upper Bay	39	CP-B	12.42	
17-Jul	1	Upper Bay	39	RFISH	16.84	8 Rec. Fishing Boats
17-Jul	2	Upper Bay	39	CFISH	18.79	
17-Jul	1	Upper Bay	39	CFISH	33.05	Commercial Fishing Boats
17-Jul	1	Upper Bay	39	CFISH	33.05	All Outside Survey Swath
17-Jul	1	Upper Bay	39	CFISH	33.05	
17-Jul	1	Upper Bay	39	CFISH	33.05	
17-Jul	2	Upper Bay	39	RFISH	34.10	
17-Jul	1	Upper Bay	48	CP-B	0.82	
17-Jul	2	Upper Bay	48	CP	0.82	
17-Jul	1	Upper Bay	48	CP	9.00	
17-Jul	2	Upper Bay	48	CFISH	10.82	
17-Jul	2	Upper Bay	48	RFISH	11.00	
17-Jul	2	Upper Bay	48	RFISH	12.45	
17-Jul	1	Upper Bay	48	CFISH	20.59	
17-Jul	1	Upper Bay	48	CP-E	42.59	
17-Jul	2	Upper Bay	48	CP-E	43.64	
17-Jul	1	Upper Bay	52	CP-B	1.89	
17-Jul	2	Upper Bay	52	CP-B	0.84	
17-Jul	2	Upper Bay	52	CB	1.68	
17-Jul	2	Upper Bay	52	CP	1.68	
17-Jul	1	Upper Bay	52	CP	5.26	

17-Jul	2	Upper Bay	52	CFISH	12.63	
17-Jul	1	Upper Bay	52	CP	27.47	
17-Jul	2	Upper Bay	52	CP	32.42	
17-Jul	2	Upper Bay	53	CP-B	6.86	
17-Jul	1	Upper Bay	53	CP-B	28.38	
17-Jul	2	Upper Bay	53	RFISH	44.32	
17-Jul	2	Upper Bay	53	CP	49.82	
07-Aug	1	Lower Bay	6	CP	3.47	
07-Aug	2	Lower Bay	6	RFISH	3.47	
07-Aug	2	Lower Bay	6	RFISH	3.47	
07-Aug	2	Lower Bay	6	RFISH	3.47	
07-Aug	1	Lower Bay	6	CP-B	4.32	
07-Aug	2	Lower Bay	6	RFISH	4.84	
07-Aug	1	Lower Bay	6	POTS	22.53	Seabass, Whelk, or Crab
07-Aug	1	Lower Bay	6	POTS	27.79	Seabass, Whelk, or Crab
07-Aug	2	Lower Bay	8	CFISH	8.78	
07-Aug	2	Lower Bay	8	CFISH	8.78	
07-Aug	1	Lower Bay	8	CP-E	26.48	
07-Aug	2	Lower Bay	8	CP-B	26.52	
07-Aug	2	Lower Bay	8	CB	27.48	
07-Aug	2	Lower Bay	8	CB	27.48	
07-Aug	2	Lower Bay	8	CB	27.48	
07-Aug	2	Lower Bay	8	CFISH	29.56	
07-Aug	2	Lower Bay	19	CFISH	0.50	
07-Aug	2	Lower Bay	19	CFISH	0.50	
07-Aug	1	Lower Bay	19	CB	5.94	
07-Aug	1	Lower Bay	19	CB	5.94	
07-Aug	1	Lower Bay	19	CP-B	12.78	
07-Aug	2	Lower Bay	19	CFISH	35.56	
07-Aug	1	Lower Bay	19	CP-E	36.78	
07-Aug	1	Lower Bay	21	CP-B	3.00	
07-Aug	2	Lower Bay	21	CFISH	2.96	
07-Aug	2	Lower Bay	21	CP	20.22	
07-Aug	2	Lower Bay	21	CP	24.39	
07-Aug	1	Lower Bay	21	CP-E	25.26	
07-Aug	2	Lower Bay	21	CP	25.52	
07-Aug	2	Lower Bay	21	CFISH	28.30	
07-Aug	2	Lower Bay	21	CP-E	29.17	
07-Aug	1	Lower Bay	21	CB	29.87	
07-Aug	2	Upper Bay	37	CP-B	2.58	
07-Aug	1	Upper Bay	37	CP-B	3.68	
07-Aug	2	Upper Bay	37	CFISH	4.79	
07-Aug	2	Upper Bay	37	CFISH	15.79	
07-Aug	2	Upper Bay	37	RFISH	24.74	
07-Aug	1	Upper Bay	37	CP-E	31.16	
07-Aug	2	Upper Bay	42	CB	1.68	
07-Aug	1	Upper Bay	42	CP-B	3.41	

07-Aug	2	Upper Bay	42	CP-B	3.36
07-Aug	2	Upper Bay	42	CP-E	33.09
07-Aug	2	Upper Bay	45	CP-B	2.40
07-Aug	1	Upper Bay	45	CP-B	4.40
07-Aug	1	Upper Bay	45	CP-E	35.70
07-Aug	2	Upper Bay	45	CP	9.40
07-Aug	1	Upper Bay	50	CP-B	1.10
07-Aug	2	Upper Bay	50	RFISH	1.70
07-Aug	2	Upper Bay	50	CP	9.40
07-Aug	2	Upper Bay	50	CP	18.15
07-Aug	2	Upper Bay	50	CP	31.45
07-Aug	1	Upper Bay	50	CB	34.71
07-Aug	2	Upper Bay	50	RFISH	35.85
07-Aug	1	Upper Bay	50	CP-E	44.62
07-Aug	2	Upper Bay	50	CP-E	47.00
28-Aug	2	Lower Bay	1	RFISH	6.89
28-Aug	2	Lower Bay	1	RFISH	6.89
28-Aug	1	Lower Bay	1	CP-B	11.18
28-Aug	2	Lower Bay	1	RFISH	13.00
28-Aug	2	Lower Bay	1	RFISH	13.00
28-Aug	2	Lower Bay	1	RFISH	13.00
28-Aug	2	Lower Bay	1	RFISH	13.00
28-Aug	2	Lower Bay	1	RFISH	13.00
28-Aug	2	Lower Bay	1	RFISH	16.17
28-Aug	2	Lower Bay	1	RFISH	16.17
28-Aug	2	Lower Bay	1	RFISH	16.17
28-Aug	2	Lower Bay	1	RFISH	17.67
28-Aug	2	Lower Bay	1	RFISH	17.67
28-Aug	2	Lower Bay	1	RFISH	17.67
28-Aug	2	Lower Bay	5	RFISH	31.46
28-Aug	2	Lower Bay	5	RFISH	33.67
28-Aug	2	Lower Bay	5	RFISH	36.17
28-Aug	2	Lower Bay	5	RFISH	37.17
28-Aug	1	Lower Bay	5	RFISH	15.08
28-Aug	1	Lower Bay	5	CP	23.25
28-Aug	2	Lower Bay	5	CP	51.58
28-Aug	2	Lower Bay	5	RFISH	53.63
28-Aug	2	Lower Bay	5	RFISH	53.63
28-Aug	1	Lower Bay	16	CB	27.17
28-Aug	2	Lower Bay	16	CB	1.17
28-Aug	1	Lower Bay	16	CD	29.89
28-Aug	2	Lower Bay	16	CP-B	1.72
28-Aug	1	Lower Bay	16	CB	30.94
28-Aug	1	Lower Bay	16	CB	30.94
28-Aug	2	Lower Bay	16	CB	2.78
28-Aug	2	Lower Bay	16	CP	2.78
28-Aug	2	Lower Bay	16	CP	6.61

28-Aug	2	Lower Bay	16	CB	7.11	
28-Aug	2	Lower Bay	16	CP-E	7.11	
28-Aug	1	Lower Bay	16	CP-B	37.44	
28-Aug	1	Lower Bay	23	CP-B	2.95	
28-Aug	2	Lower Bay	23	CP	2.77	
28-Aug	2	Lower Bay	23	CFISH	18.41	
28-Aug	2	Lower Bay	23	CFISH	19.27	
28-Aug	1	Lower Bay	23	CP-E	22.19	
28-Aug	2	Lower Bay	23	CP	23.05	
28-Aug	2	Lower Bay	23	CP	28.05	
28-Aug	2	Lower Bay	23	CD	30.18	
28-Aug	2	Lower Bay	23	CFISH	32.91	
28-Aug	2	Lower Bay	23	CFISH	32.91	
28-Aug	2	Lower Bay	23	CP	33.18	
28-Aug	1	Upper Bay	33	CP-B	3.48	
28-Aug	2	Upper Bay	33	CP-B	2.29	
28-Aug	1	Upper Bay	33	RFISH	5.24	
28-Aug	2	Upper Bay	33	RFISH	4.38	
28-Aug	2	Upper Bay	33	RFISH	4.38	
28-Aug	2	Upper Bay	33	RFISH	4.38	
28-Aug	1	Upper Bay	33	CP-E	25.71	
28-Aug	2	Upper Bay	33	CP-E	25.43	
28-Aug	1	Upper Bay	44	MH	15.40	
28-Aug	1	Upper Bay	44	MH	15.40	
28-Aug	1	Upper Bay	44	CB	35.45	
28-Aug	1	Upper Bay	44	CP-E	38.70	
28-Aug	2	Upper Bay	44	CP	39.95	
28-Aug	1	Upper Bay	47	CP-B	2.21	
28-Aug	2	Upper Bay	47	CP-B	1.85	
28-Aug	2	Upper Bay	47	CFISH	11.95	
28-Aug	1	Upper Bay	47	POTS	25.00	
28-Aug	2	Upper Bay	47	CP	24.15	
28-Aug	1	Upper Bay	47	CB	31.68	Setting Pots
28-Aug	1	Upper Bay	47	CP-E	39.26	
28-Aug	2	Upper Bay	47	CP-E	39.00	
28-Aug	1	Upper Bay	55	CP-B	3.86	
28-Aug	2	Upper Bay	55	CP-B	3.43	
28-Aug	1	Upper Bay	55	CP	7.91	
28-Aug	2	Upper Bay	55	CFISH	11.81	
28-Aug	2	Upper Bay	55	CFISH	22.43	
28-Aug	1	Upper Bay	55	CP	22.46	
28-Aug	1	Upper Bay	55	CD	39.09	
28-Aug	1	Upper Bay	55	CD	39.09	
28-Aug	1	Upper Bay	55	CP-E	42.00	
06-Sep	2	Lower Bay	5	CFISH	5.23	
06-Sep	1	Lower Bay	5	RFISH	5.17	
06-Sep	2	Lower Bay	5	RFISH	17.27	

06-Sep	2	Lower Bay	5	RFISH	36.14	
06-Sep	2	Lower Bay	5	RFISH	36.14	
06-Sep	2	Lower Bay	5	RFISH	36.14	
06-Sep	2	Lower Bay	5	RFISH	36.14	
06-Sep	2	Lower Bay	5	RFISH	36.14	
06-Sep	2	Lower Bay	6	RFISH	11.47	
06-Sep	2	Lower Bay	6	RFISH	11.47	
06-Sep	2	Lower Bay	6	RFISH	11.47	
06-Sep	1	Lower Bay	9	CP-B	3.19	
06-Sep	1	Lower Bay	23	CP-B	2.95	
06-Sep	2	Lower Bay	23	CP	22.27	
06-Sep	1	Lower Bay	23	CP-E	23.15	
06-Sep	1	Lower Bay	23	CB	24.95	
06-Sep	1	Lower Bay	23	CB	30.55	
06-Sep	2	Lower Bay	23	CP	33.86	
06-Sep	2	Upper Bay	38	RFISH	0.29	
06-Sep	1	Upper Bay	38	CP-B	3.29	
06-Sep	2	Upper Bay	40	CP	1.50	
06-Sep	1	Upper Bay	40	RFISH	30.32	
06-Sep	2	Upper Bay	40	RFISH	35.00	15 Boats
06-Sep	1	Upper Bay	40	CP-E	33.53	
06-Sep	2	Upper Bay	40	RFISH	40.25	
06-Sep	2	Upper Bay	40	RFISH	40.25	
06-Sep	2	Upper Bay	40	RFISH	40.25	
06-Sep	2	Upper Bay	40	MH	41.50	
06-Sep	2	Upper Bay	40	RFISH	41.50	8 Boats
06-Sep	2	Upper Bay	40	CP-E	44.10	
06-Sep	1	Upper Bay	40	RFISH	44.47	
06-Sep	2	Upper Bay	45	RFISH	0.96	
06-Sep	2	Upper Bay	45	RFISH	0.96	
06-Sep	1	Upper Bay	45	CP-B	3.82	
06-Sep	1	Upper Bay	45	RFISH	7.23	
06-Sep	2	Upper Bay	45	CP	38.13	
06-Sep	1	Upper Bay	45	CP-E	40.77	
06-Sep	2	Upper Bay	54	CP	2.50	
06-Sep	2	Upper Bay	54	CP	5.68	
06-Sep	1	Upper Bay	54	CP-B	6.68	
06-Sep	2	Upper Bay	54	RFISH	13.18	
06-Sep	2	Upper Bay	54	CP	25.00	
06-Sep	2	Upper Bay	54	CP	26.82	
06-Sep	2	Upper Bay	54	CP	33.64	
02-Oct	2	Lower Bay	11	CD	27.86	
02-Oct	2	Lower Bay	11	CFISH	26.50	
02-Oct	2	Lower Bay	11	CFISH	27.27	
02-Oct	2	Lower Bay	11	CFISH	27.27	
02-Oct	2	Lower Bay	11	CP	26.50	
02-Oct	2	Lower Bay	18	CP	2.00	

02-Oct	2	Lower Bay	18	CP	5.33	
02-Oct	1	Lower Bay	18	CP-B	5.56	
02-Oct	2	Lower Bay	18	CP-B	0.89	
02-Oct	2	Lower Bay	26	CFISH	18.50	
02-Oct	2	Lower Bay	26	CP	18.50	
02-Oct	2	Lower Bay	26	CP	22.08	
02-Oct	2	Lower Bay	26	CP	27.92	
02-Oct	2	Upper Bay	33	CP	25.61	
02-Oct	1	Upper Bay	36	CB	29.48	
02-Oct	1	Upper Bay	36	CB	29.48	
02-Oct	2	Upper Bay	36	CFISH	26.24	
02-Oct	1	Upper Bay	36	CP	3.86	
02-Oct	1	Upper Bay	36	CP-E	24.10	
02-Oct	2	Upper Bay	36	RFISH	26.24	
02-Oct	2	Upper Bay	46	CP	2.83	
02-Oct	2	Upper Bay	46	CP	5.50	
02-Oct	1	Upper Bay	46	CP-E	44.61	
02-Oct	2	Upper Bay	46	CP-E	44.56	
02-Oct	1	Upper Bay	46	POTS	37.33	
02-Oct	1	Upper Bay	49	CP-B	2.05	
02-Oct	1	Upper Bay	49	POTS	19.62	
02-Oct	2	Upper Bay	49	RFISH	41.43	
16-Oct	1	Lower Bay	8	CP-B	1.96	
16-Oct	1	Lower Bay	8	POTS	18.04	
16-Oct	2	Lower Bay	8	RFISH	18.87	10 Boats
16-Oct	1	Lower Bay	10	POTS	17.87	
16-Oct	2	Lower Bay	10	RFISH	24.56	10 Boats
16-Oct	1	Lower Bay	15	CB	7.62	7 Boats
16-Oct	2	Lower Bay	15	CFISH	2.90	
16-Oct	1	Lower Bay	15	CP-B	7.62	
16-Oct	1	Lower Bay	15	RFISH	6.38	6 Boats
16-Oct	2	Lower Bay	15	RFISH	2.90	
16-Oct	2	Lower Bay	15	RFISH	21.10	
16-Oct	2	Lower Bay	15	RFISH	35.52	4 Boats
16-Oct	1	Lower Bay	18	CB	26.50	
16-Oct	2	Lower Bay	18	CP	32.16	
16-Oct	1	Lower Bay	18	CP-E	27.89	
16-Oct	2	Lower Bay	18	RFISH	2.74	
16-Oct	2	Lower Bay	18	RFISH	29.42	
16-Oct	2	Lower Bay	18	RFISH	30.74	
16-Oct	1	Upper Bay	33	CP-B	4.32	
16-Oct	1	Upper Bay	33	CP-E	23.46	
16-Oct	2	Upper Bay	33	RFISH	0.35	
16-Oct	2	Upper Bay	33	RFISH	25.26	

APPENDIX F. Aerial sightings of marine mammals, June-October 2001.

Codes:
MM = Marine Mammal
MMD = Dead Marine Mammal
MM POD = Marine Mammal Pod

DATE	OBSERVER	REGION	TRANSECT	CATEGORY	DISTANCE (m)	COMMENTS
12-Jun	1	Upper Bay	56	MM	8.63	
12-Jun	1	Lower Bay	19	MM	1.58	
12-Jun	1	Lower Bay	19	MM	1.58	
12-Jun	2	Lower Bay	19	MM	3.00	
12-Jun	2	Lower Bay	19	MM	3.00	
12-Jun	2	Lower Bay	19	MM	3.00	
12-Jun	2	Lower Bay	19	MM	6.00	
12-Jun	1	Lower Bay	19	MM	31.58	
12-Jun	2	Lower Bay	14	MM	31.76	
19-Jun	1	Lower Bay	9	MM	4.10	
19-Jun	1	Lower Bay	9	MM	4.10	
19-Jun	2	Lower Bay	9	MM	9.00	
19-Jun	2	Lower Bay	9	MM	9.00	
19-Jun	2	Lower Bay	9	MM	12.00	
19-Jun	1	Upper Bay	32	MM	13.79	
19-Jun	2	Upper Bay	32	MM	26.67	
19-Jun	2	Upper Bay	32	MM	26.67	
19-Jun	2	Upper Bay	32	MM	26.67	
19-Jun	2	Lower Bay	9	MM POD	27.00	
26-Jun	1	Lower Bay	19	MM	6.50	
26-Jun	2	Lower Bay	19	MM	21.80	
26-Jun	2	Lower Bay	19	MM	21.80	
26-Jun	2	Lower Bay	19	MM	21.80	
26-Jun	2	Lower Bay	19	MM	21.80	
26-Jun	2	Lower Bay	19	MM	21.80	
10-Jul	1	Lower Bay	7	MM	25.76	
10-Jul	1	Lower Bay	14	MM	2.00	
10-Jul	1	Lower Bay	14	MM	2.00	
10-Jul	1	Lower Bay	14	MM	2.00	
10-Jul	1	Lower Bay	7	MM POD	26.05	20+ dolphins
10-Jul	2	Lower Bay	7	MM POD	27.90	8 Dolphins
10-Jul	2	Lower Bay	7	MM POD	28.67	15 Dolphins (2 Pods)
10-Jul	1	Lower Bay	14	MMD	27.46	Dead Dolphin
17-Jul	1	Upper Bay	52	MM POD	7.37	Approx. 6 in Pod
28-Aug	1	Lower Bay	1	MMD	17.65	

06-Sep	1	Lower Bay	9	MM	5.86	
06-Sep	1	Lower Bay	9	MM	5.86	
06-Sep	1	Lower Bay	9	MM	5.86	
06-Sep	2	Upper Bay	54	MM	19.55	
06-Sep	1	Upper Bay	45	MM POD	11.68	8+ Dolphins
02-Oct	1	Upper Bay	46	MM	8.39	